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Enumeration and Coded-Wire Tagging of Coho Salmon *(Oncorhynchus kisutch)* Smolts Leaving Black Creek, French Creek and the Trent River, Vancouver Island, During 1988

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ENUMERATION AND CODED-WIRE TAGGING OF COHO SALMON (*Oncorhynchus kisutch*) SMOLTS LEAVING BLACK CREEK, FRENCH CREEK AND THE TRENT RIVER, VANCOUVER ISLAND, DURING 1988

by

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ABSTRACT

Fielden, R. J., G. J. Birch, and J. R. Irvine. 1989. Enumeration and coded-wire tagging of coho salmon (*Oncorhynchus kisutch*) smolts leaving Black Creek, French Creek and the Trent River, Vancouver Island, during 1988. Can. MS Rep. Fish. Aquat. Sci. 2018: 85 p.

This report presents the results of a coho salmon (*Oncorhynchus kisutch*) smolt enumeration and coded-wire tagging program conducted in Black Creek, French Creek and the Trent River during April to June, 1988. The program was part of a stream indexing study on Vancouver Island coho streams that was started in 1985. The primary purpose of our study was to document size and timing aspects of juvenile coho migration from Statistical Area 14 streams and, through coded-wire tagging of emigrants, to improve the understanding of subsequent ocean migration routes and timing, catch incidence and production dynamics. Downstream movements of juvenile coho and other fish were monitored in each study stream through a screened "V" or double "V"-type fence and live box trap. Daily catches of juvenile coho were sampled for fork length, weight, eye diameter and scale age. A total of 76,404 Black Creek, 27,568 French Creek and 18,704 Trent River coho smolts were captured. It was estimated that the total coho run from upstream of the fences was 77,000 smolts in Black Creek, 29,000 smolts in French Creek and 23,000 smolts in the Trent River. The date by which 50% of the catch was trapped occurred on May 16 in Black Creek, May 26 in French Creek and May 21 in the Trent River. A total of 75,210 Black Creek coho smolts, 26,618 French Creek smolts and 18,484 Trent River smolts were coded-wire tagged and released. The Black Creek run was separated into two different size groups (greater than or less than 120 mm) within seven different timing groups for a total of 14 coded tag groups. A total of 48,969 small coho and 26,241 large coho were tagged in Black Creek. Smolts from the other two river systems were not separated into size groups, but assigned different tag codes for different migration periods. The French Creek run was divided into four timing groups and the Trent River run was divided into two timing groups. Tag retention over 24 - 48 h holding periods was estimated at 99.6% for coded-wire tagged smolts from all three systems. Black Creek coho smolts were, on average, larger than those from the other systems (weighted mean length = 113.2 mm, weighted standard deviation s_w = 1.69 mm). French Creek smolts (weighted mean length = 101.1 mm, s_w = 1.4 mm) were similar in size to Trent River smolts (weighted mean length = 103.9 mm, s_w = 1.8 mm). Large smolts were caught during the beginning of the runs in all three systems. As the runs continued, average size decreased and became more uniform. Adult and juvenile steelhead/rainbow and cutthroat trout were caught emigrating in varying numbers from each of the study streams. Recommendations for subsequent years operations included changes in staff gauge locations and fence sites, fence design and operational timing, manpower allocations, timing of and marks used in evaluation of trap efficiency, and size class separations for coded-wire tagging.

Key words: Black Creek, French Creek, Trent River, juvenile coho, *Oncorhynchus kisutch*, migrations, coded-wire tagging, size composition.

RÉSUMÉ

Fielden, R. J., G. J. Birch, and J. R. Irvine. 1989. Enumeration and coded-wire tagging of coho salmon (*Oncorhynchus kisutch*) smolts leaving Black Creek, French Creek and the Trent River, Vancouver Island, during 1988. Can. MS Rep. Fish. Aquat. Sci. 2018: 85 p.

Le présent rapport porte sur les résultats d'un programme de dénombrement et d'étiquetage de tacons coho (*Oncorhynchus kisutch*), au moyen de micromarques magnétisées codées, qui a été réalisé d'avril à juin 1988 dans Black Creek, French Creek et Trent River. Le programme faisait partie d'une étude d'indexation des échappées dans les rivières à coho de l'île de Vancouver, qui a été lancée en 1985. L'étude visait avant tout à recueillir des données sur l'ampleur et le moment des migrations de coho juvéniles quittant les cours d'eau de la zone 14 et, grâce au marquage des migrateurs, à améliorer notre connaissance des parcours empruntés au cours de la migration subséquente vers l'océan, du moment de cette migration, de l'importance des prises et du rendement des cours d'eau en question. Dans chacun des cours d'eau visés par l'étude, nous avons contrôlé les déplacements en aval de coho juvéniles et d'autres poissons à l'aide d'une barrière grillagée en forme de "V" ou de "W" et d'une boîte-piège. Un échantillonnage a été fait parmi les coho juvéniles capturés chaque jour pour en déterminer la longueur à la fourche, le poids, le diamètre des yeux et l'âge des écailles. Au cours de l'étude, 76 404 tacons coho en provenance de Black Creek, 27 568 tacons venant de French Creek et 18 704 tacons provenant de Trent River ont été capturés. Selon nos estimations, le nombre total de coho migrateurs venant d'en amont des barrières s'est chiffré à 77 000 tacons dans le cas de Black Creek, 29 000 pour French Creek et 23 000 pour Trent River. La date à laquelle le nombre de poissons interceptés a atteint 50% du nombre capturé a été le 16 mai pour Black Creek, le 26 mai dans le cas de French Creek et le 21 mai pour Trent River. Au total, 75 210 tacons coho provenant de Black Creek, 26 618 tacons partis de French Creek et 18 484 tacons de Trent River ont été étiquetés de micromarques magnétisées codées, puis relâchés. Les poissons provenant de Black Creek ont été répartis en deux groupes de taille différente (plus grand ou plus petit que 120 mm), lesquels ont été subdivisés en sept groupes selon la date de migration, ce qui donnait 14 groupes de codage au total. Dans le cas de Black Creek, on a marqué 48 969 petits coho et 26 241 gros coho. Les tacons provenant des deux autres réseaux hydrographiques n'ont pas été classés d'après leur taille, mais ils ont été codés différemment selon la période de migration. C'est ainsi que les poissons de French Creek ont été divisés en

quatre groupes et ceux de Trent en deux. On estime que 99,6% des tacons marqués dans les trois réseaux ont conservé leurs micromarques pendant des périodes de capture de 24-48 heures. Les tacons de Black Creek étaient en moyenne plus gros que ceux des autres réseaux (longueur moyenne pondérée = 113,2 mm, écart type pondéré E_p - 1,69 mm). La taille des tacons de French Creek (longueur moyenne pondérée = 101,1 mm E_p = 1,4 mm) s'apparentait à celle des tacons de Trent River (longueur moyenne pondérée = 103,9 mm, E_p = 1,8 mm). Dans le cas des trois réseaux, les plus gros tacons ont été capturés au début des migrations. Par la suite, la taille moyenne des poissons a diminué, devenant aussi plus uniforme. Un certain nombre de truites de mer, truites arc-en-ciel et truites fardées, adultes et juvéniles, ont également été capturées pendant qu'elles migraient des cours d'eau à l'étude. Les auteurs font des recommandations pour les années à venir, proposant des changements du point de vue de l'emplacement des échelles limnimétriques et des barrières, de la conception et des dates de mise en service des barrières, de la répartition de la main-d'oeuvre, du calendrier et des moyens employés pour évaluer l'efficacité des pièges et du mode de répartition par classe de grandeur pour les fins d'étiquetage.

Mots clés: Black Creek, French Creek, Trent River, coho juvéniles, *Oncorhynchus kisutch*, migrations, micromarques magnétisées codées, répartition par taille.

INTRODUCTION

RATIONALE

Symons and Waldichuk (1984) estimated that accurate recruitment assessments could lead to a 20% increase in the harvest rates of Pacific salmon. With this in mind, an intensive investigation of recruitment rates and escapement estimation has been undertaken in recent years to improve the management of the resource. There are over 100 discrete populations of coho salmon (*Oncorhynchus kisutch*) within B.C. (Aro and Shepard 1967) and to intensively investigate each population would be impossible. Walters (1984) suggested that the coho populations of a few streams be chosen to investigate escapement, rates of harvest, and stock-recruitment relationships and to determine whether one coho population within an area could be used as an index for coho in other streams within the area. To evaluate if stream indexing is feasible, it must be determined if different coho populations within an area follow similar fluctuations in size and, if not, what factors influence population levels. With these relationships clarified, one or more streams can be chosen as indicators of stock productivity across populations within an area. Three streams were chosen for an index study along the east coast of Vancouver Island in Statistical Area 14; Black Creek, French Creek and the Trent River (Figure 1). This study was conducted to monitor juvenile coho production from the above systems, and to carry out sufficient coded-wire tagging of emigrant smolts to allow subsequent evaluations of adult migration routing as well as contributions to harvest and escapement.

Every fall since 1985, adult fish counting fences have been located on French Creek, Black Creek and Trent River to monitor coho escapements. Smolt enumeration fences have been located on these three systems each spring, with the exception of French Creek during 1985, so that coho smolts could be enumerated, and the relationship between escapement and recruitment investigated. This report presents the results of the data collected during the smolt enumeration program conducted on these three systems between April and June, 1988.

OBJECTIVES

The general objectives of this research program are: to improve the understanding of coho migration routes and timing through the fishery; to document the incidence of capture of Canadian produced coho in the American fishery; to improve the knowledge of the production dynamics of coho salmon; and to examine the importance of size and timing of emigration for coho smolts. The specific objectives of the work outlined in this report included:

1.) installation, efficient operation and maintenance of juvenile salmon "V" and double "V" enumeration fence traps in Black Creek, the Trent River and French Creek;

2.) enumeration of coho smolts and other fish leaving these systems;

3.) coded-wire tagging of as large a proportion as possible of the migrant coho smolt migration, with separate tag codes used for different time periods in each system and also for different sizes of smolts in Black Creek, and estimation of tag loss or retention rates;

4.) daily sampling of coho fork lengths, weights, eye diameters and scales in each of the systems with scale sample collection stratified by time and size; and

5.) monitoring of water levels and water temperatures during fence operations.

PREVIOUS STUDIES

An adult fish enumeration fence was first constructed on Black Creek in 1968 and a partial upstream migration of 4,646 coho was counted (Labelle 1987). An adult fence was re-established in 1972 and was operated intermittently by the B.C. Ministry of Environment (MOE), Fish and Wildlife Branch until 1980. The objective of operating this fence was the capture of cutthroat trout (*Salmo clarki*) brood stock. A juvenile enumeration fence was first operated on the system in 1978 and 1979 to monitor the emigration of coho smolts (Clark and Irvine 1989). In 1978, 46,405 coho smolts were counted through the fence of which 29,906 were coded-wire tagged and released. In 1979, 46,566 coho were counted and 39,326 were tagged and released. The present program was started in 1985 with the establishment of a temporary adult fence located approximately 400 m from the creek mouth. A "V"-type juvenile trap similar in design to that described by Conlin and Tutty (1979) was constructed that spring.

Among general fisheries information available for the study systems are the annual salmon escapement estimates carried out by local Fishery Officers and summarized by Brown et al. (1977) and Hancock and Marshall (1985). A catalogue of chum spawning streams on the east coast of Vancouver Island also included French Creek (Fraser et al. 1974), and a major hydrology, fisheries and environmental review of the Black Creek drainage is available (Hamilton 1978). As part of the current stream indexing studies, Johnston et al. (1987) examined alternative escapement estimation techniques for coho in French Creek and similar work is currently being carried out on all three systems (Bocking et al. 1988).

Enhancement work has been conducted on the three systems. Coho outplanting was carried out in Black Creek in 1980 and 1985, and cutthroat trout were reared in ponds for subsequent release by the MOE from 1980-82 (B. Hurst, DFO Resource Enhancement Branch, Nanaimo; D. Hayward, MOE Recreational Fisheries Branch, Vancouver Island Hatchery; pers. comm.). On

French Creek, a small hatchery, operated by local volunteers, was established in 1982 to enhance coho stocks. Local volunteers have attempted to enhance Trent River stocks of coho and steelhead as well, using a small satellite hatchery built in 1979 on Morrison Creek, a Puntledge River tributary.

STUDY AREA

Black Creek is a small stream located on the east coast of Vancouver Island between Courtenay and Campbell River. The creek originates from the slopes of Mount Washington and meanders irregularly for 26 km through a mixture of second growth forest, swamp and farm land before flowing into Alma Bay. Flows range from a high of 30 $m^3 \cdot sec^{-1}$ in the winter to no flow during the summer (Labelle 1987). The low gradient of the stream, combined with abundant lake (Northy and Morrison Lakes) and swamp habitat, serve to moderate the flows. The creek water is very dark in colour, due to dissolved organic material from the swamps in the system.

Black Creek is an exceptionally productive coho stream for its size. Escapements to the system during 1985, 1986 and 1987 were estimated at 5,043, 5,028 and 785 adults, respectively (1985 and 1986 data cited in Labelle 1987). Coho spawning is concentrated in the upper reaches and in the tributaries, especially Miller Creek, Kelland Rd. Creek and Surgenor Creek (Hancock and Marshall 1985). Black Creek also supports populations of searun and resident cutthroat, and resident rainbow trout and steelhead (*Salmo gairdneri*).

The Black Creek adult and juvenile enumeration fences are located within Miracle Beach Provincial Park, immediately downstream of Seaview Road (Figure 1). The site is just above the upper reaches of tidal influence.

French Creek originates from the slopes of Mount Arrowsmith and meanders irregularly for approximately 20 km through tree farms in the headwaters and farm and residential land in the lower reaches before flowing into the Strait of Georgia, a few kilometers north of Parksville. The creek has a steeper gradient than Black Creek and, since the system does not include any lake habitat and has little swamp habitat, discharge and water levels respond quickly to precipitation and the stream has been known for flash flooding (Hancock and Marshall 1985). The creek divides into two forks about 12 km upstream from the mouth. A waterfall on the west fork makes it impassable to fish about 400 m above the confluence. Flows peak at 15 $m^3 \cdot sec^{-1}$ in the winter, and the lower reaches of the creek are often dry during the summer (Labelle 1987).

Coho escapements to French Creek were estimated at 1,523, 995 and 114 adults during 1985, 1986 and 1987, respectively (1985 and 1986 data given by Labelle 1987). Although not as productive a coho producer as Black Creek, French Creek contains higher populations of resident and searun cutthroat and steelhead trout. Small numbers of chum salmon (*O. keta*) also spawn in the lower reaches of the creek (Fraser et al. 1974).

Local volunteers have released coho fry into the creek that were hatched and raised at the French Creek hatchery, so in recent years the French Creek coho stock has been a mixture of hatchery and wild fish. The adult enumeration fence, operated each season since 1985, and the juvenile enumeration fence, installed annually since 1986, have been located near the hatchery, approximately 2 km upstream from the creek mouth (Figure 1).

The Trent River originates in the Beaufort Range, south of Courtenay, and flows for 30 km before entering Comox harbour. This system is the largest and flashiest of the three streams studied, with flows that range from zero in the summer to 150 $m^3 \cdot sec^{-1}$ during the fall and winter (Labelle 1987). Only the lower 9 km of the system are accessible to anadromous fish, and the accessible habitat is characterized by a primarily bedrock substrate with little channel debris.

The lack of spawning gravel and rearing habitat makes the Trent River a poor producer of coho. Coho escapements for 1985, 1986 and 1987 were estimated at 1,472, 1,515 and 909 adults, respectively (1985 and 1986 data given by Labelle 1987). Generally, the Trent River is a better chum producer with estimated escapements that have reached 3,000 spawners (Hancock and Marshall 1985).

Like French Creek, the Trent River is an enhanced stream. Local volunteers have released coho fry into upstream areas inaccessible to anadromous fish since 1981.

Each fall since 1985, the Trent River adult coho counting fence has been located in the intertidal area just below the island highway (highway #19) bridge (Figure 1). The juvenile enumeration fence has been positioned approximately 1 km from the river mouth, or about 300 m above the highway bridge. The river divides into several channels at this point with two channels fenced to trap the juvenile emigration.

METHODS

FENCE CONSTRUCTION AND TRAP OPERATIONS

The fences at the three sites were similar in design to those used in the previous years (Labelle 1987), and similar to the downstream smolt fence described by Conlin and Tutty (1979). Each of the fences were constructed from materials and prebuilt components available from previous years but repaired where necessary.

The Black Creek fence was the first to be installed in 1988, and was fishing by the afternoon of April 9. The fence remained "fish tight" or impassable to fish throughout the duration of the project until it was dismantled due to low water levels on June 24. The Black Creek fence was comprised of screened panels placed in a "V"-shaped configuration. A 25 cm

diameter PVC pipe lead from the apex of the "V" to an interconnecting series of three 1.2 m x 0.9 m x 0.9 m plywood boxes (Photo 1). Hinged gates were placed in several of the panels, which could be opened during high water if damage to the fence appeared possible. Six holding boxes were located downsteam of the trap to hold coho smolts for tagging, recovery, or tag retention checks. A simple adult trap was installed on May 20 to intercept any adult steelhead moving upstream. The adult trap consisted of a broomstick panel, about 4 m long, that extended from the bank to one side of the juvenile trap. One broomstick was removed to allow upstream migranting adult fish to enter the trap enclosure formed by one side of the juvenile fence, the bank and the broomstick panel.

The French Creek fence and holding boxes were very similar to the Black Creek fence in design (Photo 2) except that only four holding boxes were used. An adult trap, similar to that used on Black Creek, was installed on May 12. The fence started fishing on April 12 and was kept "fish tight" until it was dismantled on June 13.

The Trent River fence consisted of two separate fence sections which were installed across two channels of the river. The fence on the north branch was "V" shaped, while the south branch fence was a double "V" configuration (Photo 3). The Trent River fence contained three trap boxes, one at each apex, which were each constructed of two interconnecting plywood boxes. Three holding boxes were required at the Trent River site. The fence on the north branch was installed first and was fishing by April 15. The south branch was first fished on April 20. The Trent River fences were breached or opened up on four occasions. The river overflowed the structure on April 28, putting the fence out of commission until May 1. High flows on May 13 and 16 required the fence gates to be opened for two 8 h periods to prevent overflow. The fence was last fished on June 2 when high flows again resulted in the structure being breached. Several days later, when the water levels subsided, both fence sections were dismantled. An adult trap box was placed at the upstream apex of the double "V" on the south fence on April 26 to intercept any upstream steelhead migrants.

WEATHER, PHYSICAL AND GENERAL OBSERVATIONS.

Weather observations were made daily at each fence site between 07:00 and 09:00 h. Percentage cloud cover, wind direction and wind speed were estimated visually. Precipitation type and strength were coded from 1 to 5 using the following codes: 1=clear, 2=drizzle, 3=showers, 4=heavy, or 5=snow.

Water temperatures and levels were measured near the fence sites at the same time that weather observations were taken. Maximum, minimum and present temperatures were recorded to the nearest 0.5°C. Water levels were monitored to the nearest 0.01 m. Water levels at Black Creek were recorded from the old staff gauge used in previous years located just above the Seaview Road bridge. Since levels at this gauge appeared to be biased by the head of water built up by the fence, another staff gauge was located about 200 m farther upstream. Measurements were taken at both gauges but levels from the upstream gauge were used in this report. Two water gauges were also used on

French Creek. The original staff gauge, attached to the adult fence abutment, was clearly influenced by the head of water upstream of the juvenile fence. The second staff gauge was installed approximately 100 m downstream of the juvenile fence, and it was the readings from this latter gauge that are discussed in this report. The staff gauge on the Trent River was located about 100 m below the Esquimalt and Nanaimo (E & N) railway trestle and did not appear to be affected by the fence head. Preliminary discharge data were also obtained from the Water Survey of Canada (WSC) for Black Creek (station #08HD014) and French Creek (station #08HB038) for inclusion in the report.

TRAP EFFICIENCY

An attempt was made to test the trapping efficiency of the fences by releasing groups of marked coho above the fences and monitoring the number recaptured. Four groups of 100 and one group of 400 marked coho were used to measure trapping efficiency in Black Creek. The dates when 100 coho bearing specific marks were released included: (1) adipose clipped fish on April 25, (2) right maxillary clipped fish on May 21, (3) both upper and lower caudal clipped fish on June 1, and (4) left maxillary clipped fish on June 9. A sample of 400 upper caudal clipped coho smolts was released above the Black Creek fence on May 11 - 12. In French Creek, a group of 200 upper caudal clipped coho was released above the fence on May 13, and 100 coho with the same mark were released upstream of the Trent River fence on May 19.

BIOLOGICAL SAMPLING

Each morning of the study, the number of coho smolts caught were estimated by adding the number of mortalities, the number released or escaped and the number tagged. All non-coho were removed from the trap, identified, counted and released. Upstream migrant steelhead trout caught in the broomstick traps were similarily treated.

A random sample of 25 smolts were selected from the trap catch at each fence site. These fish were anaesthetized using a solution of 2-phenoxyethanol, measured for fork length ($\pm$ 0.25 mm) and weighed on an Ohaus Port-o-Gram scale ($\pm$ 0.03 g). Each fish was also sampled for eye diameter with vernier calipers ($\pm$ 0.05 mm). Eye diameter was defined as the greatest distance between the margins of the scleral cartilage on a line along the vertical axis of the cornea (Schubert and Federenko 1985). Scale sampling procedures followed the stratified sampling method described by Ricker (1975). An attempt was made to collect 10 scale samples from each 5 mm size class of coho smolts within each coded-wire tag timing group. Coded wire tag groups represented different time periods within each run, as well as size groups for Black creek smolts. In subsequent analysis, the resulting subsample ages are applied to the frequency of each size class and summed to provide the overall population age structure. Smolts of the required sizes were collected from the catch to complete the size class subsamples when the stratified subsample requirements had not been met with fish from the random sample. When trap

catches exceeded 200 smolts·day^{-1}, the fish that were sampled were usually released untagged to reduce the potential for mortalities due to stress.

When mortalities occurred during checks for coded-wire tag placement or during the course of normal fence operations, the dead smolts were frozen and later examined for sex and measured for fork length. Sufficient samples for sex ratio analysis were collected only from Black Creek and French Creek.

The weighted mean smolt length, weight and eye diameter were calculated for each tag group and system using the equation given below (Sokal and Rohlf 1981). This calculation weights mean sizes by the number of fish caught on the dates measurements were taken. The standard deviations were similarly weighted (M. Staley, IAS International Analytical Science Ltd., Vancouver, pers. comm.).

$$\text{Weighted Mean } \overline{Y_w} = \frac{\sum^{n_i} w_i \overline{Y_i}}{W}$$

$$\text{Weighted Variance } s_w^2 = \frac{\sum^{n_i} w_i \left(\sum^{n_{ij}} (y_{ij} - \overline{Y_w})^2 \right)}{W(N-1)}$$

$$\text{Weighted Standard Deviation } s_w = \sqrt{s_w^2}$$

where: n_i = number of days i smolts were caught and sampled;
n_{ij} = number of smolts j sampled on day i;
$N = \sum^{n_i} n_{ij}$ = total number of smolts sampled for the season;
y_{ij} = size measurement for smolt j sampled on day i;
$\overline{Y_i}$ = mean size measurement for sample collected on day i;
w_i = number of smolts caught on day i; and
$W = \sum^{n_i} w_i$ = total smolt catch for the season.

CODED-WIRE TAGGING

The Black Creek coho migration was divided into seven different timing groups. Within each time period, coho were also sorted into smolts greater than or less than 120 mm fork length. Large and small coho were sorted by hand and held for tagging in separate holding pens. Attempts early in the project to separate size groups using a mechanical separator proved unsuccessful. In all, the Black Creek run was separated into 14 migration

timing and size groups, and each was tagged with a different coded-wire tag code (Table 1).

The French Creek coho emigration was divided into four different timing groups, while the coho smolts migrating from the Trent River were divided into two timing groups (Table 1). The smolts from these two systems were not separated into different size groups. Timing periods in all three systems were initially set to equally divide the run according to migration timing in previous years. These periods were, however, modified in the field according to the observed migration trends. In Black Creek, when the available tags of a given code were completely used, a new timing period was initiated and new tag codes were started for both size groups.

Coded-wire tagging methods followed accepted wild fish tagging procedures. Fish were held in covered pens out of the main current and tagged regularly. Generally, smolts were tagged every second day. During the peak of the migration (May 15 - 31), Black Creek smolts were tagged daily. Prior to starting a tagging session, the crews were organized with untagged fish close at hand, clean and cool anaesthetic baths available, correctly adjusted water flow rates through the table and recovery tanks nearby. Smolts were tagged with a Northwest Technology Ltd. MKII coded-wire tag machine. Care was taken to ensure the machine was in good working order, graded head molds were available, quality control procedures were followed and accurate tagging records were kept. Fin clip accuracy was checked frequently and the clipper was instructed as to the danger of regeneration of partial clips. While smolts were being fin clipped, they were also examined for any other clips or marks. Tag placement was checked by sacrificing several fish daily to ensure the tag was in the cartilaginous portion of the snout. Immediate tag retention was checked by passing the tagged fish through a Quality Control Device (QCD). Rejected fish were recycled through the tag checker twice and retagged, if necessary. Care was also taken to ensure that all equipment was thoroughly cleaned and checked over after each tagging session to eliminate any chance of disease transmittal between systems.

On sixteen separate occasions, 100 - 600 Black Creek smolts were held for 24 to 48 hours to check tag retention. Four 48 hour tag retention checks were done at French Creek, and two 24 hour checks were done on Trent River smolts. In each instance, held fish were passed through the QCD to check for short term tag retention rates before being released. During May 15 - 31, the migration strength in the three systems required two taggers. As a comparison of tagging efficiency, tag retention checks were carried out on groups of large and small coho smolts captured at the Black Creek fence on May 13. Each tagger used the same equipment and crew, and tagged identical groups of 150 smolts. Tag retention rates were then checked after a 48 h holding period.

RESULTS AND DISCUSSION

PHYSICAL CONDITIONS AND GENERAL OBSERVATIONS

Weather

Slightly more precipitation (24.7 mm) fell at the Comox airport during April, May and June than on average during the 30 year period 1951-1980 (Table 2) (Environment Canada, Atmospheric Environment Service, file data). April had average temperatures that were 1°C warmer than the 30 year average, while May and June were 0.3°C and 0.5°C cooler than the 30 year average, respectively.

Water temperatures and levels

During the study, Black Creek had the warmest water temperatures of the three systems (Table 3, Figure 2). Temperatures during our study ranged from a minimum of 5.0°C on April 15 to 19°C on June 23-24 (Appendix 1). French Creek temperatures varied from 5.0°C to 15°C (Figure 3), while Trent River temperatures ranged from 4.5°C to 14.5°C (Figure 4). The Trent River had the coolest water temperatures during the study period (Figure 4). For example, during May, the only month that data was collected throughout the month on all three systems, Trent River water temperatures averaged 8.8°C, 0.9°C less than French Creek and 2.2°C less than Black Creek average temperatures. Although the Trent River had the lowest mean water temperatures, it was the system with the largest daily temperature fluctuations. During May, the Trent River had mean water temperature fluctuations of 3.8°C during the 24 hour period between max-min thermometer recordings. Average daily temperature fluctuations in Black Creek of 2.7°C and in French Creek of 2.5°C were observed during the same period.

The water temperatures recorded reflect the physiographic nature of the three watersheds. Black Creek was the most sluggish system with an abundance of swamps and lakes. It had the highest water temperatures, probably due to solar heating. The Trent River had the lowest temperatures because much of it's water came from snow melt. Trent River also has a higher gradient than the other systems and fewer swamps or lakes. French Creek has a few swamps and many groundwater sources in addition to surface runoff, which again moderate the temperature regime.

The Trent River water levels fluctuated the most of the three systems (Table 4, Figure 4). The water level rose more than 0.4 m from the lowest level recorded during the study (0.47 m on June 2) to the highest recorded (0.90 m on June 3) following a heavy rainfall (Appendix 1). French Creek and Black Creek were much less responsive to precipitation (Figures 2 and 3). Black Creek water levels, measured at the furthest upstream staff

gauge, ranged from 0.22 m to 0.59 m, while French Creek water levels ranged from 0.38 m to 0.59 m at the staff gauge below the fence.

Preliminary Water Survey of Canada (WSC) discharge data for the station on Black Creek near Miracle Beach and the station on French Creek at Coombs are summarized in Table 5 and Figure 5. Discharge trends in both streams generally correlated well with water level data collected near the fence sites (Figures 2 and 5), which suggests these gauge readings were unbiased by fence operations. Peak water levels at the Black Creek fence (0.58 - 0.59 m) were observed on April 15 (immediately after gauge installation) on May 3 and on June 3 (Figure 2). The peaks in discharge during the same period at the WSC Black Creek gauge ranged from 0.36 - 0.39 $m^3 \cdot s^{-1}$ and occurred on April 15, May 2 and June 4 (Figure 5). Similarly, the minimum level of 0.33 m at the Black Creek fence was observed on June 23 - 24, and the WSC minimum level of 0.013 $m^3 \cdot s^{-1}$ was recorded on June 24. In French Creek, the maximum water level at the fence of 0.60 m was recorded on April 29, and the minimum level of 0.38 m recorded on June 13 (Figure 3). At the French Creek WSC station, the maximum discharge during the same period was 1.91 $m^3 \cdot s^{-1}$ recorded on April 29, while the minimum discharge was 0.31 $m^3 \cdot s^{-1}$ on June 13 (Figure 5).

General fence observations

It was the opinion of the field crews that near complete counts of migratory coho smolts were obtained at both French Creek and Black Creek throughout the program. The Black Creek fence, in fact, could have handled considerably higher water levels than were observed. This fence was constructed in a stream section with little gradient. When water levels during the middle of May became lower than approximately 0.45 m, plastic sheets were placed on the fence panels to build up a sufficient head to maintain a flow into the box. Water stopped flowing into the trap box on June 24, the day the trap was removed, although there was still a flow of 0.013 $m^3 \cdot sec^{-1}$ down the creek (Figure 5). Because of the predominantly gravelly substrate in the lower stream, residual flows may run underground (Hamilton 1978).

The French Creek fence was built in an area of steeper gradient, hence there was no problem in maintaining water flowing into the trap box. Flows almost topped the fence on one occasion. High winds blew debris into the creek during the early morning of April 28 during high discharge conditions. The debris accumulated against the fence, building a considerable head of water upstream. While the fence structure was stressed, the crew were able to clean away the debris before any damage was done.

The structural integrity and "fish tightness" of the Trent River fence was compromised on four occasions. On April 27, high flows topped the fence and caused several fence panels to be knocked out. It took three days for the water levels to subside sufficiently for repairs to be conducted. On May 13 and again on May 16, the gates in several of the fence panels were opened when it appeared that rising water levels would top the fence. On both occasions, the gates were closed eight hours later when water levels started to subside. Finally, high water again overflowed the fence on June 3 and the structure was dismantled when high flows subsequently decreased.

TRAP EFFICIENCY

Trap efficiencies were tested by releasing marked smolts above the fence and monitoring subsequent recoveries (Appendix 3). Such a test assumes no post-release mortality prior to recovery and no delay in post-release movements downstream. If either of these two assumptions are not met, the apparent trap efficiencies are reduced.

In Black Creek, trap efficiencies during April and May ranged from a minimum of 94% to 100% (Table 6). Trap efficiencies at the Black Creek fence were only 79% for coho released June 1, and 53% for coho released June 9. Since there was no change in the structural integrity of the fence, it is believed that the low number of marks recovered from these two releases was the result of marked fish remaining upstream of the fence. This may have been due to low water levels during the last two weeks of fence operations.

For two groups of coho released upstream of the Black Creek fence (release dates; April 25 and May 21), more marked fish were recovered than were reported to have been released (Table 6). Apparently, either the number of marked coho released or the number of recoveries was miscounted. Alternatively, for the April 25 release group which were adipose clip marked, it is possible that some of the fish clipped during the coded-wire tagging operations may have been mixed with the unprocessed trap catch.

The trap efficiency tests indicated that the Black Creek fence was on average 95% efficient, if the last two releases are discounted. It is the subjective opinion of the fence crew, however, that the fence was "fish tight" throughout its operation and that trap efficiencies approached 100%.

The recovery of marks in French Creek was relatively low (84%), although there was no apparent reason for this low recovery rate. As with Black Creek, the French Creek fence crew felt the fence was close to 100% efficient because any holes in the fence structure should have been evident as upwelling below the fence or water jets through the panels. No such problems were observed.

Only 79% of the marked smolts released above the Trent River fence were recovered. Some of these marked fish, however, may have moved downstream after the fence was flood damaged on June 2 since they had only been released two weeks before. Some caudal clipped coho released in Black Creek on May 11-12 were not recaptured for up to 25 days. While trap efficiency on the Trent River was probably less than the other two fences due to problems with frequent flooding, it is the opinion of the crew that efficiencies were much higher than demonstrated by the trap efficiency test.

Previous trap efficiency tests for juvenile enumeration fences on the three study streams were reported by Labelle (1987). In each test, only 25 fish were released above the fences. A single test at Black Creek in 1986 suggested a trapping efficiency of 80%. Tests at both French Creek and the Trent River during 1986 demonstrated 100% trapping efficiencies when the fences

were structurally sound. During a period in 1986 when the Trent River fence was breached and damaged by high water, trapping efficiency was reduced to 15%.

The question of the effect of fin clipping on the survival or metabolism of the marked fish deserves comment. In a short review of the subject, Wydoski and Emery (1983) noted that, while adipose fin removal has the least effect on fish, complete or partial removal of one or both pelvic fins or partial removal of dorsal or caudal fins as short term marks also have minimal adverse effects on fish. Partial fin clips and clipped maxillary bones usually regenerate quickly.

EMIGRATION NUMBERS AND TIMING

Coho smolts

Black Creek: A total of 76,404 coho smolts were counted through the Black Creek fence between April 11 and June 24. During the trapping and tagging program there were 146 trapping and holding mortalities, and 65 tagging mortalities. The trapping period appeared to cover most of the migration period, since very few migrants were trapped during the first and the last 10 days that the trap was in operation (Figure 6, Appendix 2). By extrapolating the trap catches outside the trapping period, an additional 73 coho smolts were estimated to have migrated downstream to produce a total run of 76,477 smolts. Since it appears from the trap efficiency tests that the trap was close to 100% efficient, this number was rounded upwards for an estimated total of 77,000 smolts migranting from the system during the spring of 1988.

Both the date of 50% of the trap catch, and the peak of migration occurred on May 16 when 9,868 smolts were caught (Table 7). The quartile dates of trap catch were likely very close to the quartile dates of migration.

The peak of migration was similar to that of previous years in which the peaks of migration ranged from May 10 to May 24 (Table 7). More smolts were trapped in 1988 than during any of the previous three years; however, the trapping period was longer than in previous years. During 1985-87, the fence was removed earlier because the water levels became too low, although considerable numbers of smolts were observed in the creek above the fence site after the fence was removed (J. Amos, Campbell River, pers. comm.). A total of 57,338 smolts were trapped during May 1 - 26, 1988, during the same period of time that 50,208 coho smolts were caught in 1985 (Table 7, Labelle 1987). The higher numbers of smolts trapped during 1988, therefore, does not necessarily mean that many more smolts migrated out of the creek than in previous years. A possible exception was 1986 when only 38,212 smolts were caught between April 20 and June 4; 74,163 smolts were caught between April 20 and June 4 in 1988.

French Creek: A total of 27,568 smolts were caught in the French Creek trap between April 13 and June 13 (Table 8, Figure 7, Appendix 2). A total of 85 trapping and holding mortalities and 57 tagging mortalities were recorded. Less than 30 smolts·day^{-1} were caught during the first six days of trapping and fewer than 200 smolts·day^{-1} were trapped during the last four days. It is

likely that less than 1,000 smolts migrated passed the trap site when it was not in operation. If the catches are extrapolated outside the trapping period, an additional 464 coho smolts migrated past the fence site resulting in a total of 28,032 migrants. It is estimated the smolt production for the system upstream of the fence during the spring of 1988 was 29,000 coho. Production downstream of the fence site, where coho spawning has been observed, was not included in this estimate.

The peak of migration occurred on May 22 when 2,310 smolts were caught (Table 8). This date was four days before 50% of the total trap catch had been caught. The actual 50% migration date likely occurred one or two days later, because there were still 100-200 smolts·day^{-1} migrating downstream when the trap was removed. The French Creek 50% catch date occurred ten days later than in Black Creek (Table 7).

There were fewer migrants caught at the French Creek fence than in the previous two years (Table 8). The 1988 peak of migration occurred one week later than in 1987 and five days earlier than in 1986.

Hatchery coho parr were outplanted into the upper reaches of the French Creek system in 1986-87. In October 1986, 1,508 right ventral (pelvic fin) clipped coho parr averaging 6 g in weight were outplanted, while in June 1987, 10,408 left ventral clipped coho averaging 1.8 g in weight were planted (B. Hurst, DFO, Resource Enhancement Branch, Nanaimo, pers. comm.). To monitor the emigration of these hatchery fish, most of the coho smolts that went through the coded-wire tagging process were examined for ventral clips, except on May 20 and 21 when the second tagger neglected to record ventral clips. Of the 27,460 smolts that were handled for sampling or tagging, an estimated 750 had left ventral clips and nine were right ventral clipped. The nine right ventral clipped fish recovered must have come from the 1986 fall release group and, therefore, had been rearing in the system for at least 18 months. A larger proportion of marked smolts were recovered at the beginning of the migration in comparison to the timing distribution of the entire run (Appendix 5), which suggests differences in emigration timing between wild and outplanted coho. The crew also noticed that the marked coho were much larger than the unmarked coho, although the difference was not documented.

Trent River: A total of 18,704 coho smolts were caught in the Trent River traps between April 16 and June 2 (Table 9, Figure 8, Appendix 2). A total of 177 trapping and holding mortalities and 8 tagging mortalities were recorded. It is difficult to estimate what the total migration of smolts was in 1988, since daily migrant numbers were variable, apparently at least partly in response to discharge, and because it is difficult to extrapolate migrant numbers on those days when the fence panels were opened or damaged by high water. If, however, the log transformed trap catches are linearly extrapolated for those periods that the fences were not in full operation, an estimated total of 21,248 coho smolts emigrated from the Trent River during 1988.

Only 100 - 222 smolts·day^{-1} were caught in the Trent River during the four days prior to the last day of fishing on June 2, 1988. However, water levels rose dramatically on June 3 and it is possible that higher numbers of smolts migrated following the higher water levels than indicated in Figure 8. Approximately 3,500 smolts migrated downstream between June 3 and June 18 in 1986, a year in which low numbers of migrants were caught. This suggests the

21,248 emigrant smolt estimate for 1988 is low. By extrapolating migrant numbers during non-operational periods prior to June 2 and by adding 3,500 migrant smolts for the period after, a total estimated migration of 23,000 smolts was generated. This is probably a more accurate estimate of emigrant smolt production from the Trent River during the spring of 1988.

The peak daily catch of 1,673 smolts was made at the Trent River on May 28, 1988 (Table 9). This date was seven days after the 50% quartile date; however, since the trap was removed when substantial numbers of coho were still migrating downstream, the actual 50% quartile date was probably a few days later. The timing of the run appears to be very close to that of 1987 despite the dates of peak catch being 16 days apart. The quartile dates for the two years are within three days of each other (Table 9). Increases in migrant numbers appear to follow increased flows which vary from year to year. Peak migrant numbers were similar between years.

Other species caught

Adult steelhead trout were caught in the downstream traps of all three systems (Appendix 2). The largest number (46) was caught in the French Creek trap, while 32 were caught in Black Creek and 26 were taken in the Trent River traps (Table 10). Of the French Creek steelhead caught, seven had not spawned and 39 were kelts. All of the Black Creek steelhead were kelts, as were all but one of the Trent River steelhead. Steelhead adults often appeared to be reluctant to move into the fence traps. For example, during mid-May, eight steelhead were observed holding in a pool above the Black Creek fence and 14 steelhead were observed above the French Creek fence. Several attempts were made to capture these fish by beach seining, but the attempts were generally unsuccessful. Only two kelts were seined from each of the systems. It is possible that some of the holding fish observed had not yet spawned, but the advanced condition of the kelts caught suggests that the low water conditions at the time resulted in the fence being an impediment to kelt emigration. Most of the adult steelhead were caught in the traps in early June after a substantial rise in water levels.

Substantial numbers of juevnile steelhead were caught in the three systems (Appendix 2). The French Creek trap caught the highest number of steelhead smolts, while the Trent River fences caught slightly fewer, although the traps were not fished as long, and the Black Creek trap caught the least (Table 10). The fence catches of juvenile cutthroat trout from the three streams suggests that the most productive system for cutthroat was French Creek, although more adult cutthroat were captured moving downstream in Black Creek (Table 10). Greater numbers of cottids were caught at the Black Creek and Trent River fences that at the French Creek fence, and the most productive system for stickleback, based on trap catches, was Black Creek (Table 10). The catch of chum salmon parr at the three fences suggests that the only stream where substantial chum spawning occurred above the fence sites was in the Trent River (Table 10). A few chum parr were, however, caught in the French Creek trap.

Probably as a result of the warmer surface water temperatures observed in Black Creek in comparison with the other two systems (Table 3), the timing of peak migration of juvenile steelhead and cutthroat trout generally

occurred earlier in Black Creek (Table 11). Peak downstream movements of adult steelhead and cutthroat trout, however, were slightly earlier in French Creek than in the other two systems.

Traps to catch upstream migrating fish were also operated at each fence. Two unspawned steelhead adults were caught in the French Creek trap on May 13, the day after the trap was installed. No adult trout were caught in the upstream traps of the other two systems.

COHO POPULATION CHARACTERISTICS

Size

The estimated size (fork length and weight) of Black Creek coho smolts over the period of trap operation was the largest (weighted mean length = 113.2 mm, weighted standard deviation s_w = 1.7 mm) of the three systems (Table 12). Trent River coho smolts were slightly larger than French Creek smolts, although the difference did not appear to be significant (Table 12).

The mean size of the emigrant coho from each system varied as the migrations progressed (Figures 9 - 11). Relatively large smolts were caught soon after the fences became operational, while small numbers of migrants were moving downstream. As the numbers of emigrants increased, the size of the coho smolts tended to decrease. The shape of the curve of mean daily nose-fork lengths over the course of the migration in Black Creek appears to be slightly sinusoidal (Figure 9). The average daily size increased from approximately 120 mm after the fence was first installed on April 10 to a maximum mean daily size of 144.2 mm on April 21. Subsequently, smolt size decreased to a minimum mean daily length of 100.6 mm on June 13. Daily mean lengths ranged from 122.7 mm to 144.2 mm during the period of peak mean daily size (April 15 - 30), while during the last two weeks of fence operations (June 10 - 24), emigrant coho ranged from 103.3 mm to 110.0 mm in mean daily nose-fork length. Weighted mean size calculations for small and large smolt tag groups from Black Creek reflected the same general decrease in size during the migration described above (Table 13).

The mean daily length of the French Creek coho smolts declined fairly continuously as the emigration progressed (Figure 10). The maximum mean daily nose-fork length of 144.0 mm was recorded on April 14, the first day of fence operations. During the first week of operations (April 14 - 21), mean daily length ranged from 102.8 mm to 144.0 mm. By the peak in migration (May 22, Table 7), the mean daily length was 104.8 mm, and, by the last week of fence operations (June 7 - 13), mean daily nose-fork length was fairly consistent between 94.6 mm and 97.7 mm. The weighted mean size calculations for French Creek coded-wire tag groups showed the same decrease in length and weight during the migration (Table 13).

Trent River mean daily smolt size exhibited a temporal pattern (Figure 11) similar to that shown by French Creek smolt emigrants (Figure 10). Relatively large smolts, ranging in mean daily length from 109.3 mm to

115.4 mm, were caught during the first week of fence operations (April 16 - 22). The range in mean daily nose-fork length declined to 98.5 mm to 107.9 mm during the last week of fence operations (May 27 - June 2). The maximum daily mean nose-fork length of 120.1 mm was recorded on April 23, while the minimum daily mean length of 96.1 mm was observed on May 19.

Smolt size also became more uniform as the run progressed in all three systems. At Black Creek, daily standard deviations of nose-fork lengths ranged from 8.8 mm to 30.3 mm during the period of peak smolt size (April 15 - 30) and 2.0 mm to 9.5 mm during the last two weeks of the study (June 10 - 24) (Figure 9). During the first week of operations at French Creek (April 14 - 21), the daily standard deviation in nose-fork length ranged from 12.6 mm to 34.3 mm, but, by the last week of operations (June 7 - 13), daily standard deviation for length ranged from 5.1 mm to 8.3 mm (Figure 10). A similar pattern was observed in the Trent River where daily standard deviations of smolt length varied from 6.5 mm to 18.1 mm during April 16 to April 22, and 4.8 mm to 8.1 mm during May 27 to June 2 (Figure 11).

The size frequency distributions of smolts randomly sampled throughout the run from all three systems are positively skewed (Figures 9 - 11). The frequency distribution of Black Creek smolts was the most highly skewed. Coho smolts 102.5 mm to 107.5 mm long were the most frequent size class. The French Creek frequency distribution was less skewed, with smolts 92.5 mm to 97.5 mm the most frequent size class. Trent River smolts had the most uniform frequency distribution. Smolts ranging from 97.5 mm to 102.5 mm in nose-fork length were in the most frequent size class.

The variability in smolt size observed among emigrant coho from the three study streams is probably due to the main type and variety of rearing habitat available, the age structure of the emigration, and the presence or absence of enhanced fish. Black Creek emigrant coho smolts were, on average, the largest observed in the three study systems and displayed the highest variability in size (Table 12, Figure 9). Coho rearing habitat in Black Creek includes extensive lake and swamp habitat, both of which have been shown to support larger sized coho juveniles in comparison to stream habitat (Fielden and Holtby 1987). As well, there are two age classes of smolts in Black Creek (Labelle 1987). Coho smolts age 2+ accounted for 7.2% of the migrants in 1986, while smolts age 1+ accounted for 92.8% of the migrants. Labelle (1987) demonstrated a clear size difference between these two age classes.

Emigrant coho smolts from French Creek and the Trent River were comparable in weighted mean size and range, and considerably smaller on average than Black Creek smolts (Table 12). In French Creek, the coho rearing habitat is primarily stream habitat, although some swamp habitat is available. French Creek has also been shown to support age 1+ and 2+ coho, although fewer of the migrants were age 2+ (0.6% of the 1986 migration, Labelle 1987). The Trent River is comprised solely of stream habitat, and Labelle (1987) reported only 0.3% of Trent River coho smolts were aged 2+. Hatchery fed fry have been outplanted into both French Creek and the Trent River. Outplanted fish often reach a larger size at migration in comparison to sympatric wild fish. Although not documented, the crew noticed that outplanted (ventral clipped) coho caught at the French Creek fence appeared to be much larger than wild fish caught at the same time. The presence of enhanced fish may account for similar variability in smolt size observed in these two systems.

Eye size

Schubert and Fedorenko (1985) found that there was less overlap of eye diameter frequency distributions of age 1+ and 2+ coho smolts than of nose-fork length frequency distributions of coho from the Pitt River. They suggested that eye diameter may be useful in separating age 1+ and 2+ smolts. Our results also suggest that eye diameter may be a useful tool for separating age classes of coho smolts.

Changes in average daily eye diameter of coho smolts from the three study systems (Figures 12 - 14) generally followed the same temporal patterns as average daily nose-fork lengths (Figures 9 - 11). The general decrease in average daily eye diameter during the emigration, along with a comparable decrease in size, suggests a correlation between size and eye diameter and age complement. The exception was the trend in average daily eye diameter for Trent River coho which appeared to increase slightly towards the end of fence operations (Figure 14) instead of decreasing as for average daily length (Figure 11).

Eye diameter frequency distributions for Black Creek (Figure 12) and French Creek (Figure 13) were bimodal which suggest that the corresponding length frequencies were skewed as a result of different age components (Figures 9 and 10). Older (age 2+) smolts supposedly are not only larger than age 1+ coho smolts but also have significantly greater eye diameters. The clearer bimodal distributions for eye diameter for these two systems infer that eye diameter may be more closely correlated with age, although the overlap in these frequency distributions is still considerable. The unimodal eye diameter and length frequency distributions for Trent River coho smolts (Figures 11 and 14) imply either low numbers of one age class, or poor correlation between the morphological measurements collected and age in this stock.

Sex ratio

A total of 103 Black Creek coho smolts and 64 French Creek coho smolts were sexed during the study. Only those fish sacrificed to establish coded- wire tag placement or mortalities incurred during normal fence operations were included in the sexed subsample. The sample was not, therefore, random and may be biased, although the mortality rate generally followed migration strength with most of the samples collected during the peak portions of the migrations. There was a much higher proportion of males than females from both systems (69 - 75%) (Table 14). There was no significant difference between the size of males and females within either system.

CODED-WIRE TAGGING OPERATIONS

Tag retention

Tag retention rates were determined periodically throughout the tagging program on each of the three systems (Appendix 4). Rates were determined on 16 occasions for Black Creek tagged coho, four occasions for French Creek coho, and two occasions for the Trent River smolts. The same tagger and the same tagging machine was used throughout the program, except for a two week period from May 15 to May 31, when a second tagger and machine were used at French Creek and Trent River. A comparison of the tagging ability of the two taggers was determined using tag retention as a measure of ability. Both taggers achieved retention rates of 100% on large smolts (n=150). The full time tagger also attained 100% tag retention with small smolts (n=150), while the second tagger achieved a retention rate of 99.3% or tag loss in one smolt out of a sample of 150. Tag retention rates were similar for all three systems, and there did not appear to be a difference between 24 h tag retention rates for Black Creek and Trent River coho samples and 48 h retention rates for Black Creek or French Creek samples (Table 15). The overall tag retention rate was 99.64%.

Tag numbers released

Total coded-wire tag releases (Table 16) were derived by subtracting the tagging mortalities from the total number of coho put through the tagging process and then multiplying that number by the average tag retention rate calculated for the three systems (99.6%) (Table 15, Appendix 4). There were an additional 36 mortalities amongst Black Creek coded-wire tagged smolts during short term holding, but exclusive of tag retention tests. These fish were also subtracted from the total number tagged prior to applying retention rates, but proportionately from large and small smolt numbers according to the tagged numbers on those days that the additional holding mortalities occurred.

A total of 75,210 Black Creek coho smolts, 26,618 French Creek coho smolts and 18,484 Trent River coho smolts passed through the tagging process and were released. Of the Black Creek coho, 48,969 small coho smolts (less than 120 mm) and 26,241 large coho smolts were tagged. Estimated numbers of adipose clipped smolts without coded-wire tags after 24 - 48 h were 301 for Black Creek (196 small coho and 105 large coho), 106 for French Creek and 74 for the Trent River. The total numbers of coded-wire tagged releases are, therefore, estimated at 74,909 smolts for Black Creek, 26,512 coho for French Creek and 18,410 coho smolts for the Trent River. When the number of holding and trap mortalities and the number of adipose clipped and tagged coho are subtracted from the total estimated smolt migration for each system, approximately 1,600 Black Creek coho, 2,300 French Creek coho and 4,300 Trent River coho were estimated to have escaped from upstream of the fence sites unclipped and untagged.

RECOMMENDATIONS

Physical measurements

The new staff gauges installed in Black Creek, French Creek and the Trent River in 1988 should be used in the future. These gauges were placed in areas that were evidently not influenced by either high tide or a water head behind the fences. Alternatively, for Black Creek and French Creek, the project could rely on the WSC station data which would provide both water level and discharge information. If discharge data are required for the Trent River, a water level-discharge curve should be developed.

Fence operations

Fence locations and design: The fence designs for Black Creek and French Creek provided complete barriers and good trapping efficiencies in 1988. Neither fence was breached, although the near breaching of the French Creek fence on April 28 demonstrates the need for frequent attention during periods of heavy precipitation and debris accumulation. Both sites required abundant reinforcement of the fence "skirts" with cobble and gravel to guard against high water damage. At low water, it was difficult to maintain flow into the trap box at Black Creek. This problem can be overcome by lining the fence and the substrate in front of the fence with plastic sheeting to increase the water head. It is possible that a higher gradient location could be found for the Black Creek fence but the ease of access, firm substrate, and closeness to the limit of tidal influence of the present site argue against any change.

Some attention should be given to selection of a better site for the Trent River fence. A site where the flow is wide spread and the substrate is firmer would be best to maximize the chance of maintaining the fence during high flows. Such a site may exist upstream of the present site, or just downstream of the railway crossing. The resulting fence would, however, be less accessible, longer, more costly to build and operate, and may require a wooden deck for secure installation.

Operational timing: All three fences could have been started as early as March to ensure monitoring of as much of the runs as possible. The added cost for the few extra fish, however, may make early initiation of operations not worthwhile. Optimally, to monitor as much of the run as possible in each system, the fences should be operated through most of April to June. The operation of the Black Creek fence from April 10 to June 24, 1988, for example, appeared to cover the coho smolt migration well as few fish were caught during the first and last weeks of operation.

To ensure adequate coverage of the migration periods for tagging purposes, however, the following time periods are recommended for future years. The Black Creek fence should be installed as early in April as possible and operated until June 15; the French Creek fence should be installed on April 20 and fished until at least June 20, and the Trent River fence should be operated

from April 25 to June 25. While the data collected in 1988 and in previous years gives a good idea of the timing of the Black Creek run, there is less information about French Creek and Trent River run timing. For this reason, the above recommended completion dates for these two fences could be delayed at least during the upcoming year and modified accordingly in future years. The recommended dates given would also allow staggering of the installation and dismantling of the fences.

Manpower: Manpower allocations for fence operations in 1988 were generally appropriate. The need to man fences throughout daylight hours, however, could be reviewed. In the past, vandalism has been a problem at the Trent River fence especially on weekends (R. Glennie, Courtenay, pers. comm.). Perhaps, the best schedule would be to fully man fences during daylight hours on weekends, but to reduce manpower to two 4 hour shifts (8 hour split shift) at other times, except during peaks in flow and migration.

Separation of size groups at the Black Creek fence required up to a manday of time per day during the peak in migration in 1988. For this reason, the provision of a summer student for a time was very helpful. If size separation is planned in the future, provision of fulltime manpower along with backup manpower at times will be necessary.

Trap efficiency: The method used in 1988 for evaluating trapping efficiency at the three fences appeared acceptable but for two qualifications. We recommend adipose clips not be used in trap efficiency tests as the potential for confusion with active coded-wire tagging operations is too great. In addition, we recommend efficiency tests be restricted to early in the program when the effects of delays in post-release emigration are minimal.

Coded-wire tagging

The coded-wire tagging procedures used in 1988 worked well. Two tagging machines and taggers were definitely necessary during the peak migration period in Black Creek, but should have been available for three instead of two weeks. In 1988, this three week period would have extended from May 10 to May 31.

An attempt to use a mechanical smolt size separator was generally unsuccessful at Black Creek in 1988. Separators, however, have been successfully used at hatcheries and the possibility of developing a model for field use deserves consideration. Based on size data collected in 1988, future separation of size groups may be worthwhile at French Creek, as well as Black Creek, but is not recommended for the Trent River run.

SUMMARY

1) As part of a stream indexing study started in 1985, traps to enumerate downstream migrating juvenile coho salmon were operated on three Vancouver Island streams: Black Creek, French Creek and Trent River.

2) The general objectives of the program were to enumerate coho smolts and other fish leaving these system. As large a proportion of the migrant coho smolts as possible were to be coded-wire tagged. Separate tag codes were used for different time periods in each system and different size groups of smolts in Black Creek. The trap catches were sampled daily for length, weight, age and eye diameter. Water levels and water temperatures were monitored daily in each system.

3) The Black Creek fence was fished continuously in 1988 from April 10 to June 24. These months were slightly wetter than on average for the 30 year mean normal which in part allowed the Black Creek fence to be operated longer in 1988 than during the previous three years (Table 2). The French Creek fence was fished continously from April 12 to June 13. The Trent River fence was operated from April 20 to June 2, but the fence was either breached or opened on four occasions.

4) Black Creek had the warmest average water temperatures (mean May temperatures = 11.0°C), French Creek temperatures were cooler (mean May temperature = 9.7°C), and Trent River water temperatures were the coolest (mean May temperature = 8.8°C) (Table 3). The water levels of the Trent River were the least stable of the three systems. Black Creek and French Creek levels varied over a range of 0.17 m and 0.11 m, respectively, during the month of May while Trent River level varied over 0.28 m (Table 4).

5) Trap efficiency tests were conducted on all three systems (Table 6). A total of 95% of the marked Black Creek smolts released were recovered, however, it is believed trapping efficiency was nearly complete since there was no evidence of any holes in the fence that smolts could have passed through. Only 79% of the Trent River marked fish were recaptured, but many of the marked fish may have moved downstream after the fence was removed. The recapture of French Creek marked fish was also relatively low (84%), however, the fence was likely close to 100% efficient as there were never any holes observed in the structure.

6) The largest number of smolts was caught in Black Creek (76,404) followed by French Creek (27,568) and the Trent River (18,704) (Table 17).

7) Besides coho smolts, juvenile steelhead/rainbow trout were the most abundant species caught in the three systems (Table 10). The French Creek trap caught the most trout (steelhead/rainbow and cutthroat) of the three systems (1,927). The Black Creek trap caught the largest number of cutthroat adults (201).

8) Black Creek coho smolts were on average larger than coho from the other two systems (Tables 12 and 13). The smolts from French Creek and Trent River were of similar size. The average smolt size was larger at the beginning of the run in all three systems. Mean daily smolt size then decreased and became progressively less variable during the period of fence operations.

9) A total of 103 Black Creek and 64 French Creek coho smolts were sexed. The majority of the smolts were males (69% and 75%, respectively, Table 14). There appeared to be no difference in the size of different sexes of coho within drainages. Since only mortalities were sexed, the possibility of sampling bias exists, but mortalities were generally proportional to the migration strength during the run making a bias unlikely.

10) Tag retention averaged 99.64% for an average holding period of 24 hours for all three systems combined. Retention rates were similar between systems (Table 15), and did not appear to increase with additional holding time (24 - 48 h).

11) A total of 75,210 Black Creek coho smolts were tagged with 14 different tag codes (Table 16). The run was divided into two different size groups (greater than or less than 120 mm) within seven different timing periods. A total of 26,618 French Creek coho smolts were tagged with four different tag codes; one code for each of four timing groups. A total of 18,484 Trent River coho smolt were divided into two timing groups and tagged with two tag codes. An estimated 1,600 Black Creek coho smolts, 2,300 French Creek smolts and 4,300 Trent River smolts emigrated from upstream of the fence sites and were not tagged or clipped.

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Table 1. Timing and codes of coho smolt coded-wire tag groups from Black Creek, French Creek and the Trent River during 1988.

System	Coho group	Tag code	Tag period
Black Cr.	Small	8/24/40	Apr 11-Apr 30
		8/24/41	May 01-May 10
		8/24/42	May 11-May 16
		8/24/43	May 16-May 19
		8/24/46	May 20-May 25
		8/24/59	May 26-June 2
		8/24/60	June 3-June 20
	Large	8/24/51	Apr 11-Apr 30
		8/24/50	May 1-May 10
		8/24/49	May 11-May 16
		8/24/48	May 16-May 19
		8/24/47	May 19-May 25
		8/24/59	May 25-June 2
		8/24/62	June 3-June 20
French Cr.		8/24/35	Apr 14-May 16
		8/24/36	May 17-May 25
		8/24/37	May 26-June 6
		8/25/03	June 7-June 13
Trent R.		8/24/38	Apr 16-May 22
		8/24/39	May 22-June 3

Table 2. Precipitation and average monthly temperatures at the Comox airport for April, May and June compared to the 30 year average, 1951-1980.

	Precipitation (mm)		Temperature (°C)	
Month	1988	30 Year ave.	1988	30 Year ave.
April	68.4	57.1	9.0	8.0
May	45.1	37.4	11.5	11.8
June	40.9	35.2	14.5	15.0

Table 3. Maximum, minimum and mean monthly water temperatures (°C) for Black Creek, French Creek and the Trent River, April to June 1988.

Month	Black Creek			French Creek			Trent River		
	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
April	9.0	13.0	5.0	8.4	11.0	6.0	7.2	10.0	5.0
May	11.0	15.0	7.0	9.7	13.0	5.0	8.8	14.5	4.5
June	13.9	19.0	9.5	10.1	15.0	8.0	N.D.	N.D.	N.D.

N.D. - no data

Table 4. Maximum, minimum and mean monthly water levels (m) for Black Creek, French Creek and the Trent River during 1988.

Month	Black Creek[a]			French Creek[b]			Trent River		
	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
April	0.50	0.58	0.45	0.50	0.60	0.45	0.58	0.79	0.48
May	0.47	0.58	0.41	0.45	0.50	0.39	0.55	0.66	0.38
June	0.42	0.59	0.33	0.41	0.47	0.38	N.D.	N.D.	N.D.

N.D. - no data
[a] - upstream staff gauge (#1)
[b] - downstream staff gauge (#2)

Table 5. Maximum, minimum and mean monthly discharge ($m^3 \cdot s^{-1}$) for Black Creek and French Creek, April to June 1988.

Month	Black Creek[a]			French Creek[a]		
	Mean	Max.	Min.	Mean	Max.	Min.
April	1.05	4.15	0.129	1.90	4.82	0.589
May	0.167	0.360	0.069	0.750	1.17	0.365
June	0.103	0.390	0.002	0.288	0.857	0.080

[a] - Water Survey of Canada (WSC) preliminary data (December 1988)

Table 6. Results of trap efficiency tests conducted at Black Creek, French Creek and the Trent River during 1988.

System	Date of release	Mark	Number released	Number recovered	Percent recovered	Number not CWT'd
Black Cr.	Apr 25	adipose	100	102[a]	100	6
	May 11-12	up. caudal	400	374	94	3
	May 21	r. max	100	102[a]	100	0
	June 01	dbl caudal	100	79	79	0
	June 09	l. max	100	53	53	1
French Cr.	May 13	up. caudal	200	168	84	2
Trent R.	May 19	up. caudal	100	79	79	0

[a] - represents an apparent miscount.

Table 7. Migration numbers and timing of coho smolts caught in the Black Creek fence trap during 1985-88.

Year	Period of operation	Total no. migrants caught	Date of peak migrat.	Peak daily no. of migrants	Quartile dates 25%	50%	75%
1988	Apr 10-Jun 24	76,404	May 16	9,868	May 10	May 16	May 23
1987	Apr 08-May 23	60,909	May 10	7,391	May 09	May 12	May 16
1986	Apr 20-Jun 04	38,212	May 24	3,912			
1985	May 01-May 26	50,208	May 19	8,800			

Table 8. Migration numbers and timing of coho smolts caught in the French Creek fence trap during 1986-88.

Year	Period of operation	Total no. migrants caught	Date of peak migrat.	Peak daily no. of migrants	Quartile dates 25%	50%	75%
1988	Apr 12-Jun 13	27,568	May 22	2,310	May 20	May 26	May 31
1987	Apr 05-Jun 05	33,844	May 15	2,025	May 12	May 18	May 23
1986	Apr 18-Jun 12	29,155	May 27	2,000			

Table 9. Migration numbers and timing of coho smolts caught in the Trent River fence trap during 1986-88.

Year	Period of operation	Total no. migrants caught	Date of peak migrat.	Peak daily no. of migrants	Quartile dates 25%	50%	75%
1988	Apr 16-Jun 02	18,704	May 28	1,673	May 14	May 21	May 26
1987	Apr 04-Jun 05	17,635	May 12	1,668	May 12	May 18	May 24
1986	Apr 26-Jun 18	11,388	May 20	2,025			
1985	May 01-Jun 14	12,952	May 24	1,129			

Table 10. Numbers of other fish species caught in the Black Creek, French Creek and the Trent River traps, April to June 1988.

System	*S.gair.*	Steelhead		Cutthroat			Trout	Cot-	Lamp-	Stickle-	Chum
	parr[a]	Smolts	Ad.[b]	Parr	Smolts	Ad.[b]	parr[c]	tids	rey	back	parr
Black Cr.	2	214	32	26	8	201	0	661	18	113	0
French Cr.	272	1,051	46	218	41	47	252	284	8	12	3
Trent R.	102	969	26	17	15	0	10	653	0	1	1,688

[a] - *Salmo gairdneri*

[b] - adults

[c] - unidentified cutthroat and rainbow parr

Table 11. Peak migrant numbers and date of cutthroat and rainbow trout caught in the Black Creek, French Creek and Trent River downstream traps, April to June 1988.

System	Species and stage	Date of peak migration	Peak daily catch
Black Creek	*S. gairdneri* parr	April 15	1
	Steelhead smolts	May 3	46
	Steelhead adults	June 10	10
	Cutthroat parr	May 12	4
	Cutthroat smolts	April 17 & May 7	3
	Cutthroat adults	April 28	24
French Creek	*S. gairdneri* parr	May 22	19
	Steelhead smolts	April 13	119
	Steelhead adults	June 3	10
	Cutthroat parr	June 4	22
	Cutthroat smolts	April 19	15
	Cutthroat adults	April 21	9
Trent River	*S. gairdneri* parr	May 26	25
	Steelhead smolts	May 23	104
	Steelhead adults	June 30	6
	Cutthroat parr	May 23	3
	Cutthroat smolts	May 23	3

Table 12. Weighted mean size, weighted standard deviation and sample range for the migration of Black Creek, French Creek and Trent River coho smolts during April to June, 1988.

System	Sample size/ catch	Length (mm) Mean, s_w (range)	Weight (g) Mean, s_w (range)	Eye size (mm) Mean, s_w (range)
Black Creek	1,599/ 76,404	113.2, 1.7 (71 - 205)	14.58, 0.70 (4.40 - 83.05)	7.17, 0.07[a] (5.4 - 11.0)
French Creek	1,420/ 27,568	101.1, 1.4 (66 - 176)	10.24, 0.50 (3.00 - 57.25)	6.36, 0.08 (4.8 - 11.9)
Trent River	742/ 18,704	103.9, 1.8 (74 - 182)	11.76, 0.71 (4.05 - 48.80)	7.10, 0.09[b] (4.9 - 9.1)

[a] - sample size = 1,553
[b] - sample size = 730

Table 13. Weighted mean size, weighted standard deviation and size range of Black Creek, French Creek and Trent River coded-wire tag groups released in 1988.

System	Group	Date	Tag code	Sample size	Mean length, s. (range) (mm)	Mean weight, s. (range) (g)	Mean eye diam., s. (range) (mm)
Black Creek	Small	Apr 11-Apr 30	8/24/40	127	112.5, 1.9 (71 - 119)	14.98, 0.48 (4.40 - 19.25)	7.0, 0.8[a] (5.4 - 8.5)
		May 1-May 10	8/24/40	73	109.7, 3.1 (85 - 119)	12.89, 0.96 (6.35 - 18.05)	7.0, 0.2 (5.9 - 8.2)
		May 11-May 16	8/24/42	94	105.9, 3.1 (89 - 119)	11.41, 0.96 (6.40 - 20.40)	6.9, 0.2 (5.5 - 8.6)
		May 16-May 19	8/24/43	66	104.6, 3.3 (93 - 119)	11.35, 1.16 (7.80 - 17.70)	6.9, 0.3 (5.9 - 8.0)
		May 19-May 25	8/24/46	134	104.8, 2.6 (80 - 118)	10.77, 0.85 (5.25 - 16.25)	7.1, 0.2[a] (6.0 - 8.0)
		May 26-June 2	8/24/59	198	103.6, 1.0 (85 - 119)	10.89, 0.83 (6.25 - 18.15)	7.1, 0.1 (6.2 - 8.1
		June 3-June 20	8/24/60	339	104.4, 1.6 (84 - 119)	11.17, 0.50 (5.05 - 17.35)	6.9, 0.1 (6.0 - 8.3)
	Total	Apr 11-June 20	All Tags	1031	105.5, 1.0 (71 - 119)	11.42, 0.32 (4.40 - 20.40)	7.0, 0.1[b] (5.4 - 8.6)
	Large	Apr 11-Apr 30	8/24/51	315	135.3, 2.8 (120 - 205)	24.52, 1.66 (16.75 - 83.05)	7.6, 0.2[c] (6.4 - 11.0)
		May 1-May 10	8/24/50	152	129.8, 2.5 (120 - 156)	21.01, 1.31 (15.85 - 48.70)	7.7, 0.2 (6.7 - 8.8)
		May 10-May 16	8/24/49	31	126.5, 2.7 (120 - 146)	19.58, 1.08 (28.15 - 14.40)	7.8, 0.2 (7.2 - 8.3)
		May 16-May 19	8/24/48	9	127.7, 5.8 (120 - 150)	22.35, 3.44 (24.60 - 18.10)	7.8, 0.2 (7.3 - 8.5)
		May 20-May 25	8/24/47	16	126.9, 5.6 (120 - 135)	19.87, 1.23 (25.20 - 17.40)	7.8, 0.2 (7.0 - 8.6)
		May 26-June 2	8/24/59	27	126.1, 3.4 (120 - 152)	18.52, 1.92 (9.55 - 32.00)	7.9, 0.3 (7.1 - 10.0)
		June 3-June 20	8/24/62	18	129.5, 1.9 (120 - 138)	21.91, 1.86 (16.25 - 33.60)	6.6, 0.5 (6.1 - 8.2)
	Total	Apr 11-June 20	All Tags	568	129.5, 1.3 (120 - 205)	21.19, 0.75 (9.55 - 83.05)	7.7, 0.1[d] (6.1 - 11.0)
French Creek		Apr 14-May 16	8/24/35	720	108.9, 2.5 (66 - 176)	13.06, 1.04 (3.00 - 57.25)	6.8, 0.13 (4.8 - 11.9)
		May 17-May 25	8/24/36	225	102.8, 3.6 (79 - 150)	10.70, 0.37 (4.90 - 52.70)	6.4, 0.2 (5.1 - 7.9)
		May 26-June 6	8/24/37	300	98.0, 2.1 (81 - 120)	9.14, 0.25 (5.10 - 16.60)	6.2, 0.2 (5.0 - 9.7)
		June 7-June 13	8/25/03	175	96.3, 2.8 (83 - 122)	8.85, 0.28 (5.50 - 18.30)	6.1, 0.2 (5.3 - 7.3)
	Total	Apr 14-June 13	All Tags	1420	101.1, 1.4 (66 - 176)	10.24, 0.50 (3.00 - 57.25)	6.4, 0.1 (4.8 - 11.9)
Trent River		Apr 16-May 22	8/24/38	467	104.1, 2.5 (74 - 182)	12.01, 1.05 (4.05 - 48.80)	7.1, 0.2[e] (4.9 - 8.5)
		May 23-June 3	8/24/39	275	103.5, 2.2 (75 - 129)	11.36, 0.73 (5.60 - 26.40)	7.2, 0.1 (5.6 - 9.1)
	Total	Apr 16-June 3	All Tags	742	103.9, 1.8 (74 - 182)	11.76, 0.71 (4.05 - 48.80)	7.1, 0.1[f] (4.9 - 9.1)

[a] - n = 121; [b] - n = 1025; [c] - n = 296; [d] - n = 548; [e] - n = 455; [f] - n = 730

Table 14. Sex ratios, and sizes of coho smolt mortalities collected from French Creek and Black Creek during 1988.

Stream	Sex	Proportion	Sample size	Length ± s
Black Creek	Male	0.69	54	100.0 ± 7.6
	Female	0.31	23	103.1 ± 11.4
French Creek	Male	0.75	10	92.2 ± 12.7
	Female	0.25	6	90.3 ± 10.1

Table 15. Tag retention rates for Black Creek, French Creek and Trent River coho smolts coded-wire tagged during 1988.

System	Average time held (h)	Sample size	Tags lost	Percent tag loss
Black Creek	24	2,135	6	99.7
French Creek	48	464	3	99.4
Trent River	24	200	1	99.5
Total		2,799	10	99.6

Table 16. Coded-wire tag release information for Black Creek, French Creek, and Trent River coho tagged in 1988.

System	Coho group	Tag code	Tag period	Tag morts.	Adipose[a] clipped releases	CWT[b] releases
Black Cr.	Small	8/24/40	Apr 11-Apr 30	2	645	642
		8/24/41	May 1-May 10	2	4,936	4,916
		8/24/42	May 11-May 16	3	9,662	9,623
		8/24/43	May 16-May 19	0	10,318	10,277
		8/24/46	May 19-May 25	9	10,123	10,083
		8/24/59	May 25-June 2	8	10,279	10,238
		8/24/60	June 3-June 20	4	3,006	2,994
	Total		Apr 11-June 20	28	48,969	48,773
	Large	8/24/51	Apr 11-Apr 30	9	4,644	4,625
		8/24/50	May 1-May 10	5	9,590	9,552
		8/24/49	May 10-May 16	1	7,598	7,567
		8/24/48	May 16-May 19	0	1,847	1,840
		8/24/47	May 20-May 25	1	853	850
		8/24/59	May 26-June 2	1	1,405	1,399
		8/24/62	June 3-June 20	0	304	303
	Total		Apr 11-June 20	17	26,241	26,136
French Cr.		8/24/35	Apr 14-May 16	15	3,980	3,964
		8/24/36	May 17-May 25	13	9,091	9,055
		8/24/37	May 26-June 6	9	11,859	11,812
		8/25/03	June 7-June 13	6	1,688	1,681
	Total		Apr 14-June 13	43	26,618	26,512
Trent R.		8/24/38	Apr 16-May 22	3	10,444	10,402
		8/24/39	May 22-June 3	5	8,040	8,008
	Total		Apr 16-June 3	8	18,484	18,410

[a] - Total release minus tagging mortalities.
[b] - Total release minus tagging mortalities and 0.4% tag loss.

Table 17. Migration numbers and timing of coho salmon smolts caught in downstream fence traps on Black Creek, French Creek and the Trent River during 1988.

System	Total no. migrants caught	Est. run size	Peak date of migration	Peak daily no. of migrants	Quartile dates		
					25%	50%	75%
Black Cr.	76,404	77,000	May 16	9,868	May 10	May 16	May 23
French Cr.	27,568	29,000	May 22	2,310	May 20	May 26	May 31
Trent R.	18,704	23,000	May 28	1,673	May 14	May 21	May 26

FIGURES

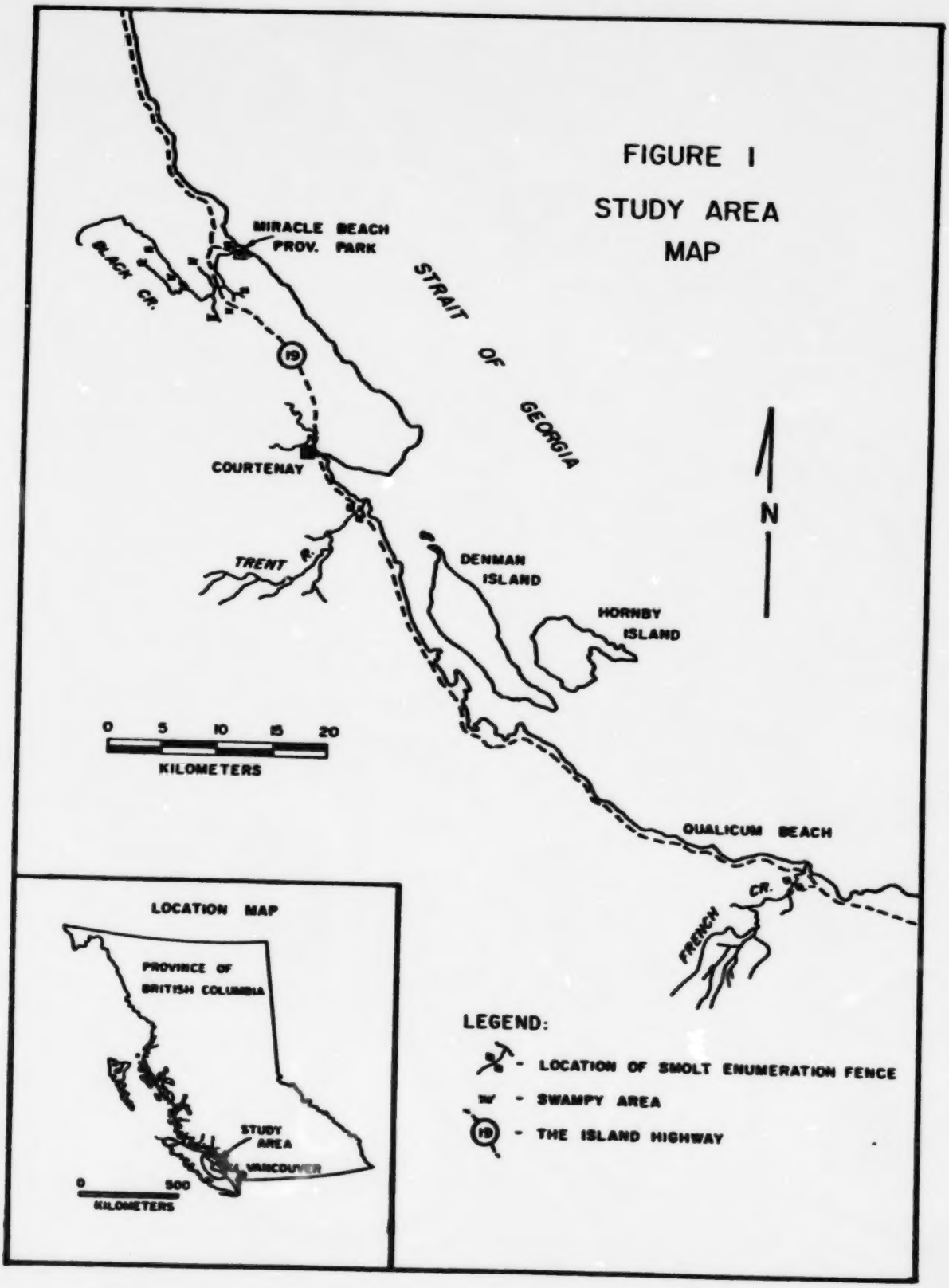


FIGURE 1
STUDY AREA
MAP
MIRACLE BEACH
PROV. PARK
BLACK CR.
19
STRAIT OF GEORGIA
COURTENAY
TRENT R.
DENMAN ISLAND
HORNBY ISLAND
N
0 5 10 15 20
KILOMETERS
QUALICUM BEACH
FRENCH CR.
LOCATION MAP
PROVINCE OF BRITISH COLUMBIA
STUDY AREA
VANCOUVER
0 500
KILOMETERS
LEGEND:
- LOCATION OF SMOLT ENUMERATION FENCE
- SWAMPY AREA
- THE ISLAND HIGHWAY

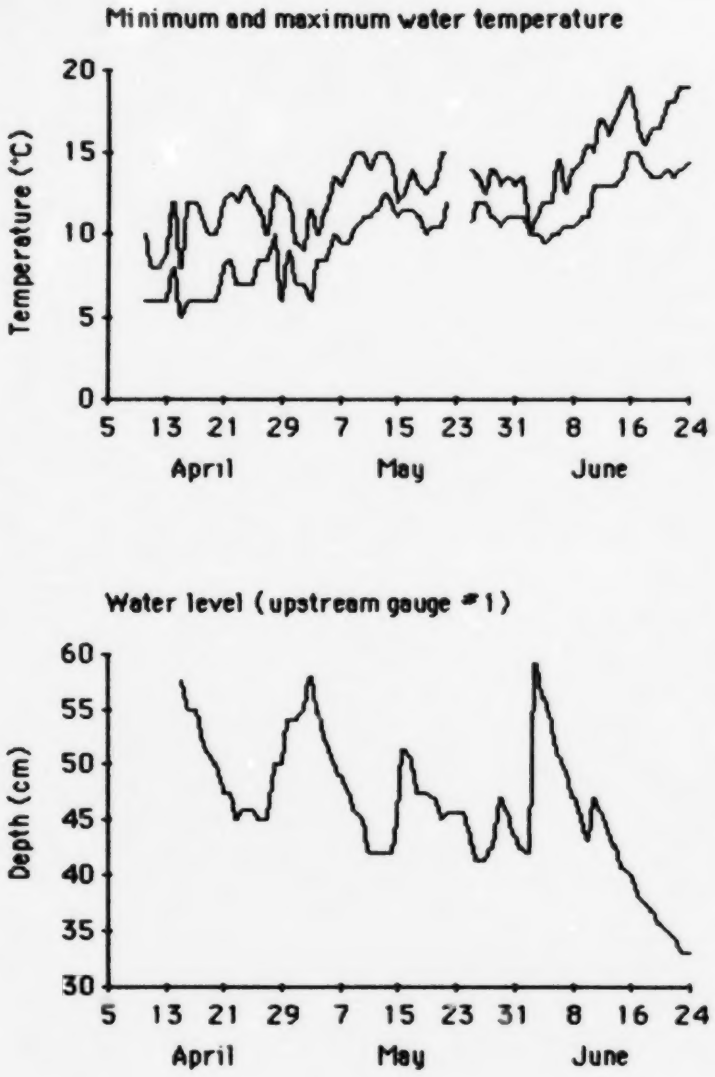


Figure 2.
Water temperature and water level measurements for Black creek, April 10 - June 24, 1988.

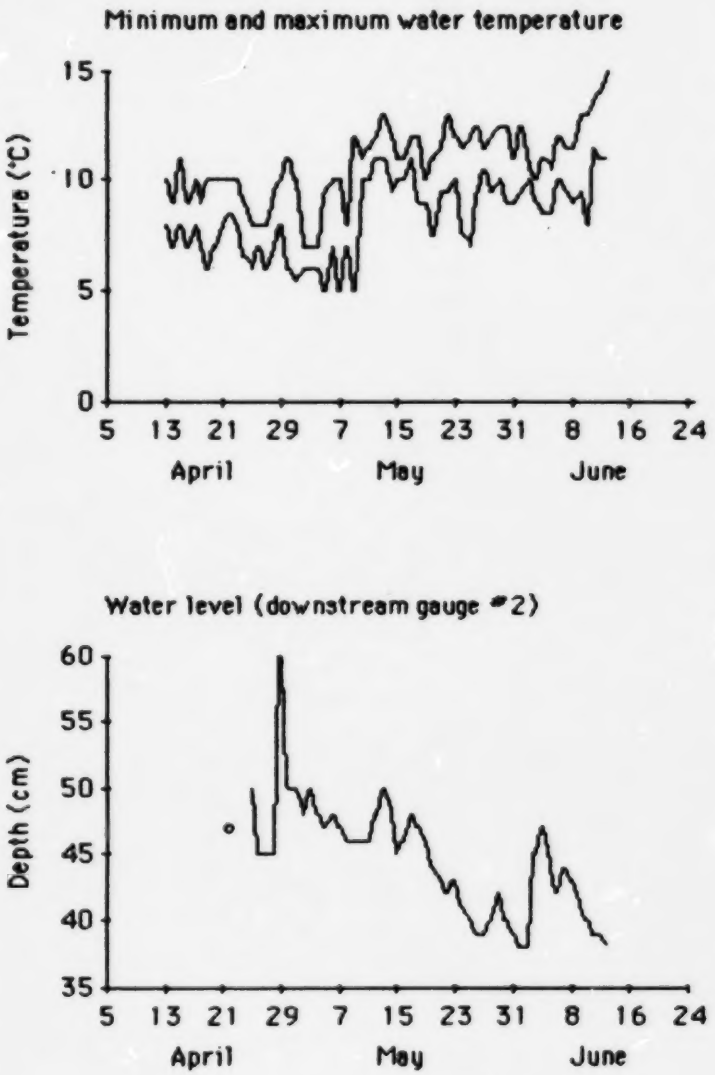


Figure 3
Water Temperature and water level measurements
for French Creek, April 13 - June 13, 1988.

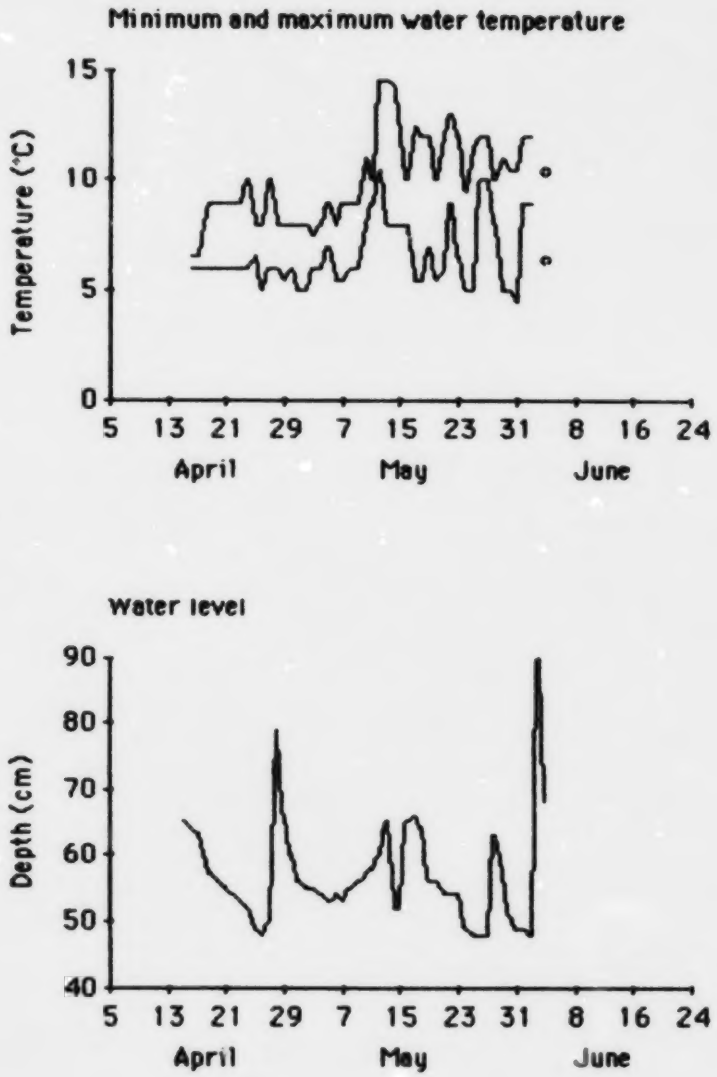


Figure 4.
Water temperature and water level measurements for the Trent River, April 15 - June 3, 1988.

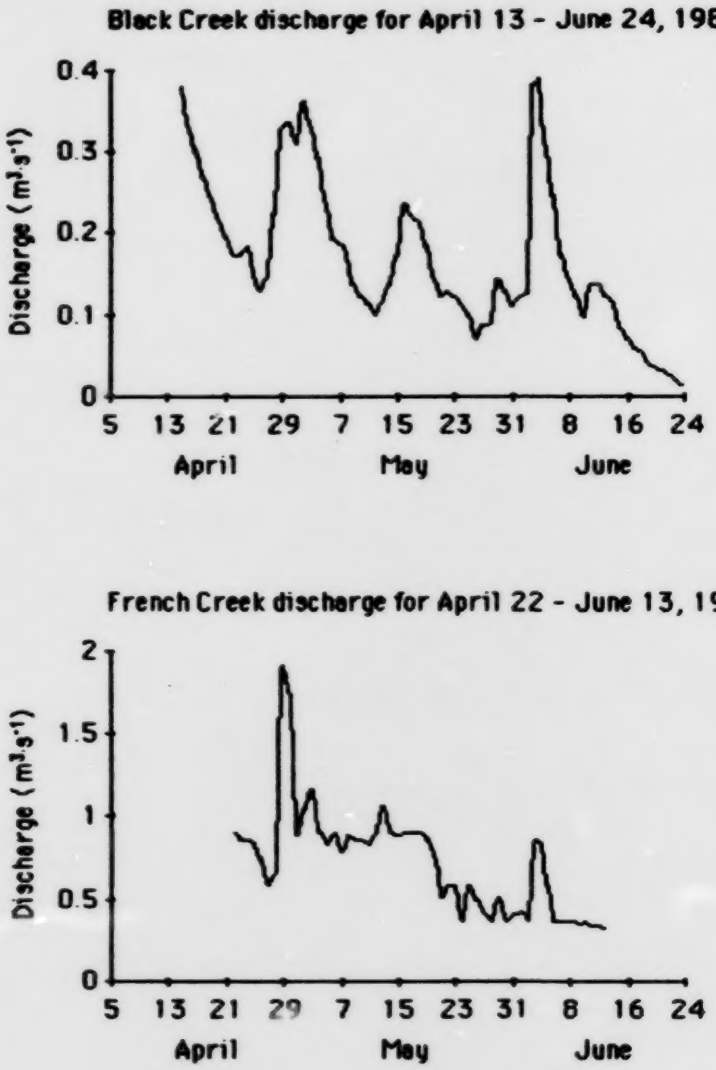


Figure 5.
Discharge trends for Black Creek and French Creek, April to June 1988

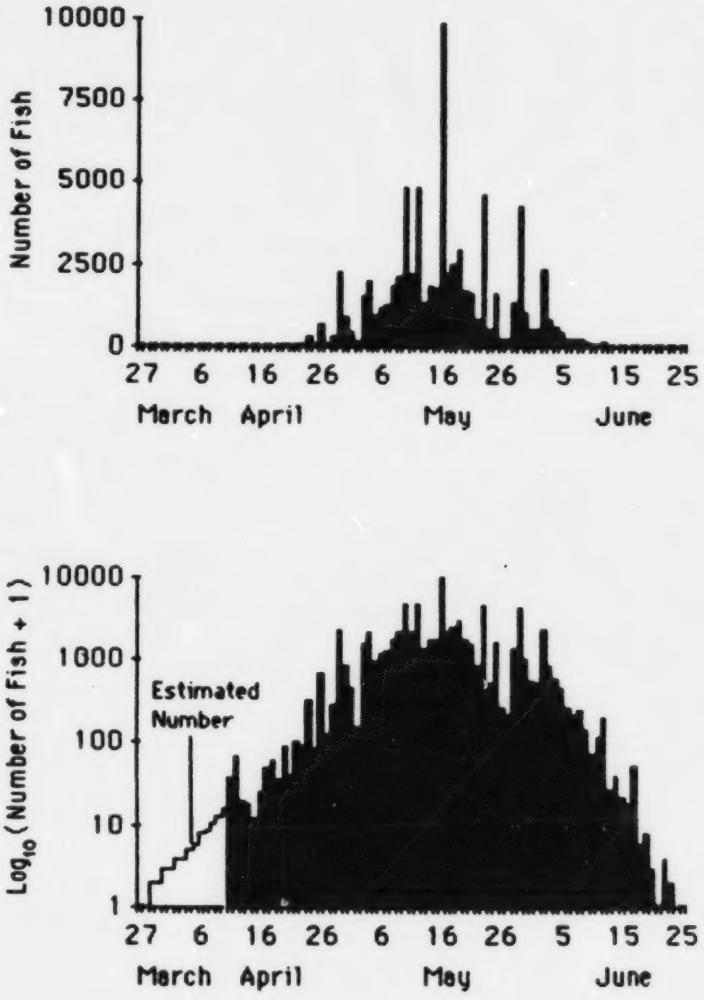


Figure 6.
Coho smolt emigration from
Black Creek, April to June 1988.

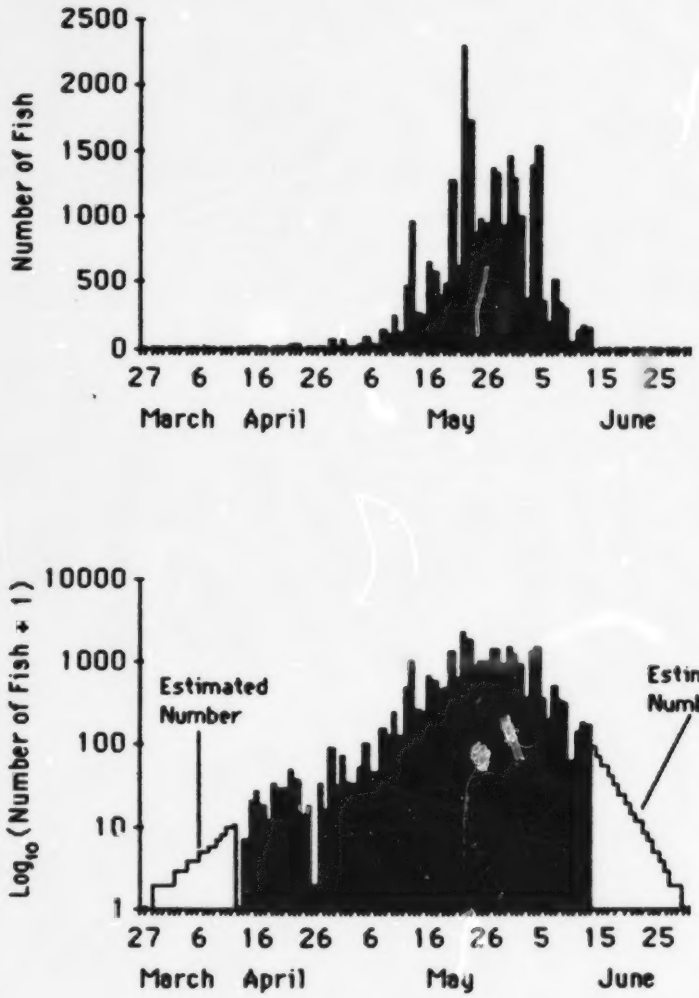


Figure 7.
Coho smolt emigration from
French Creek, April to June 1988.

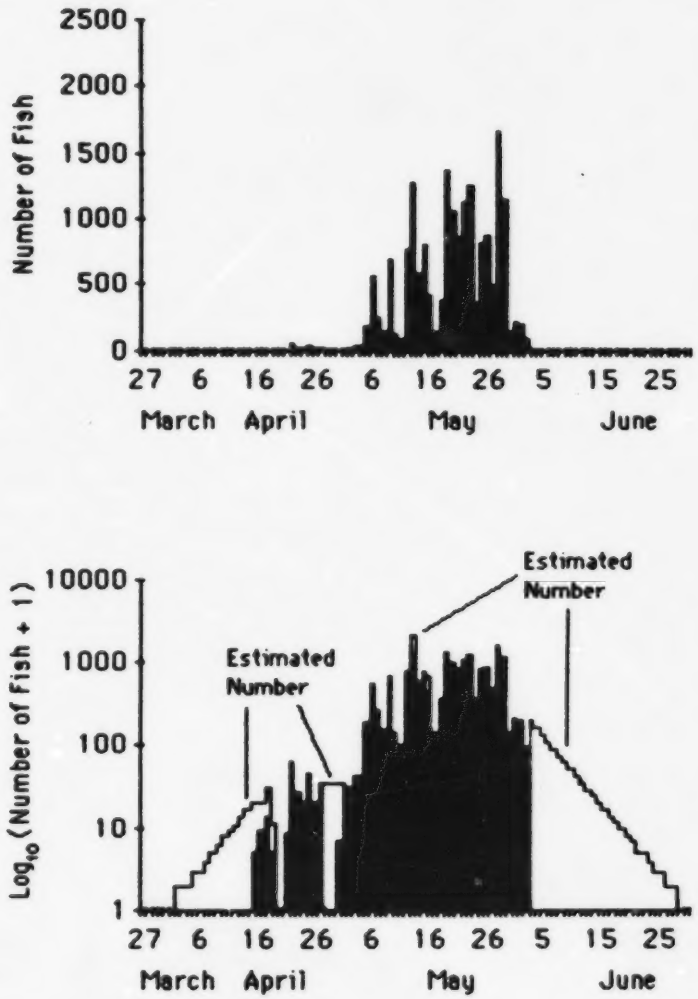


Figure 8.
Coho smolt emigration from
the Trent River, April to June 1988.

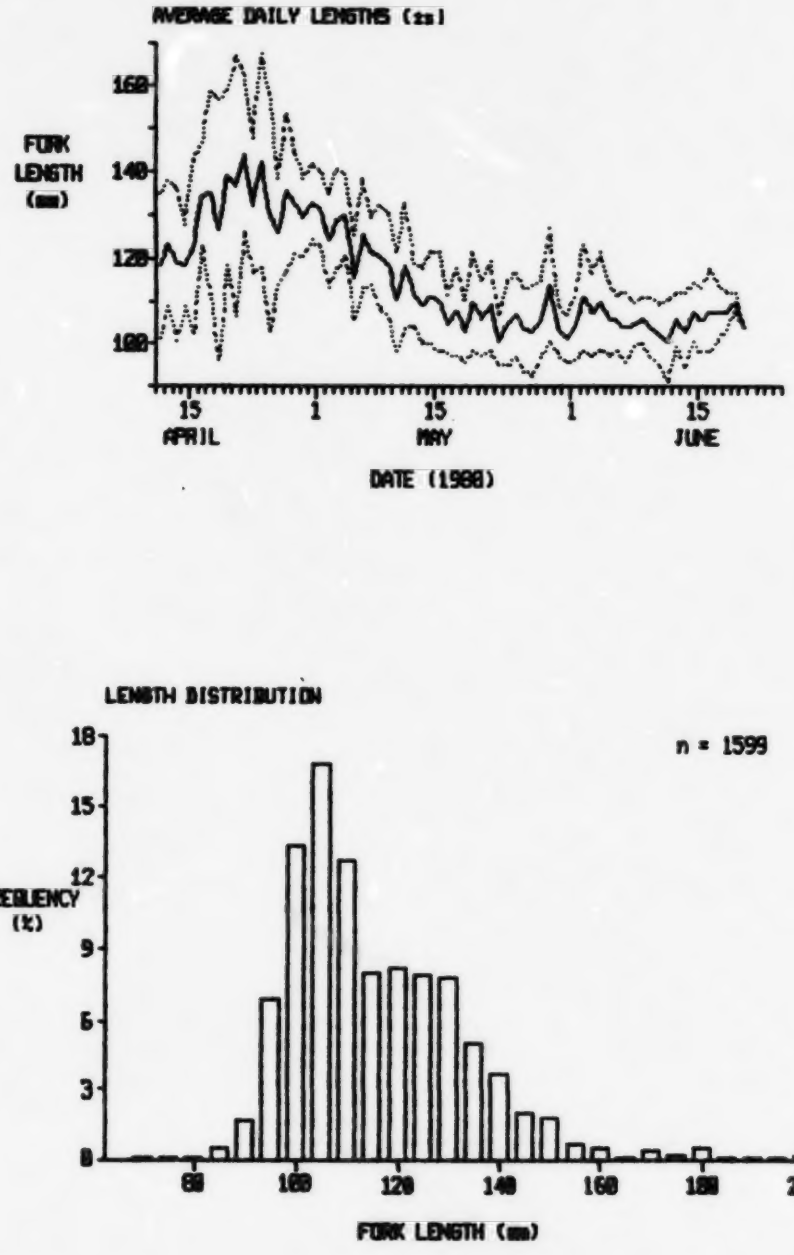


Figure 9
Average daily nose-fork lengths (± s) and length-frequency distributions of Black Creek coho smolts.

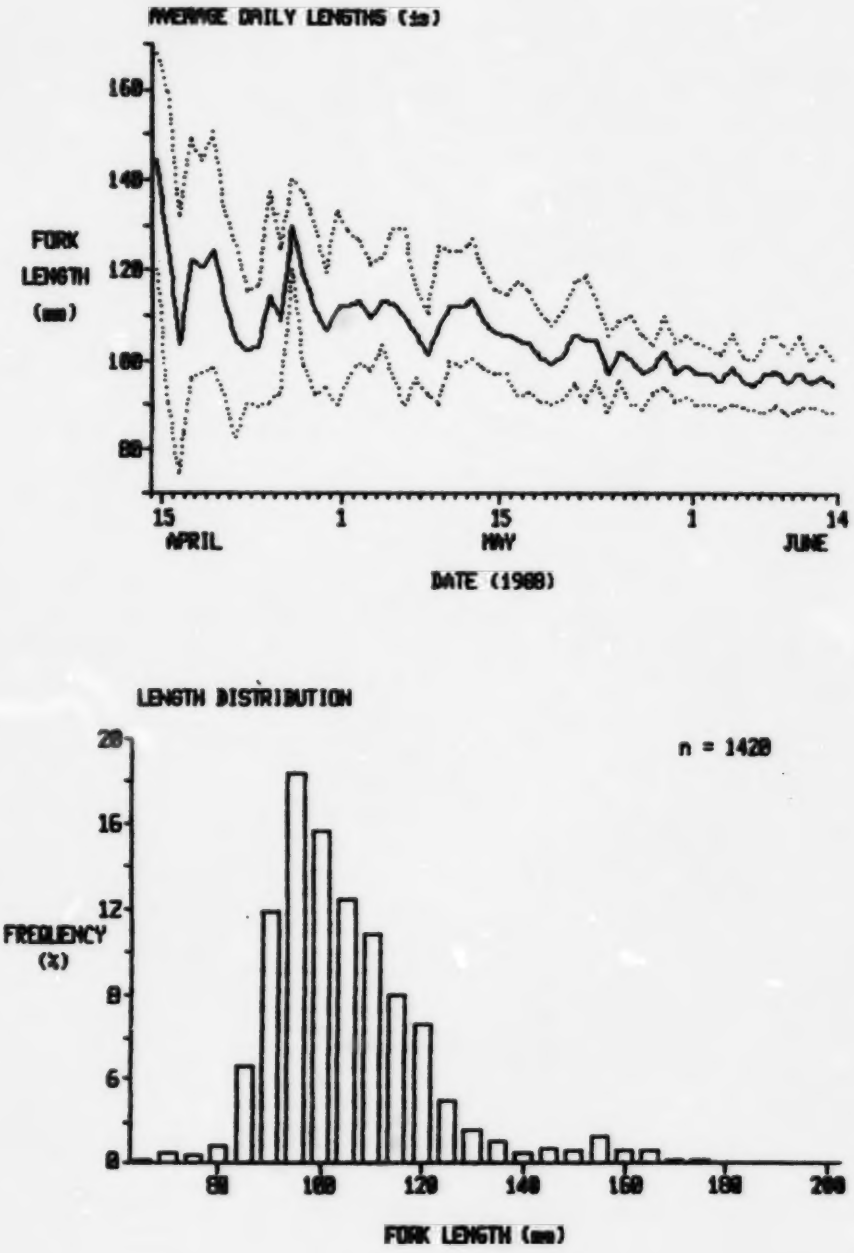


Figure 10
Average daily nose-fork lengths (± s) and length-frequency distributions of French Creek coho smolts.

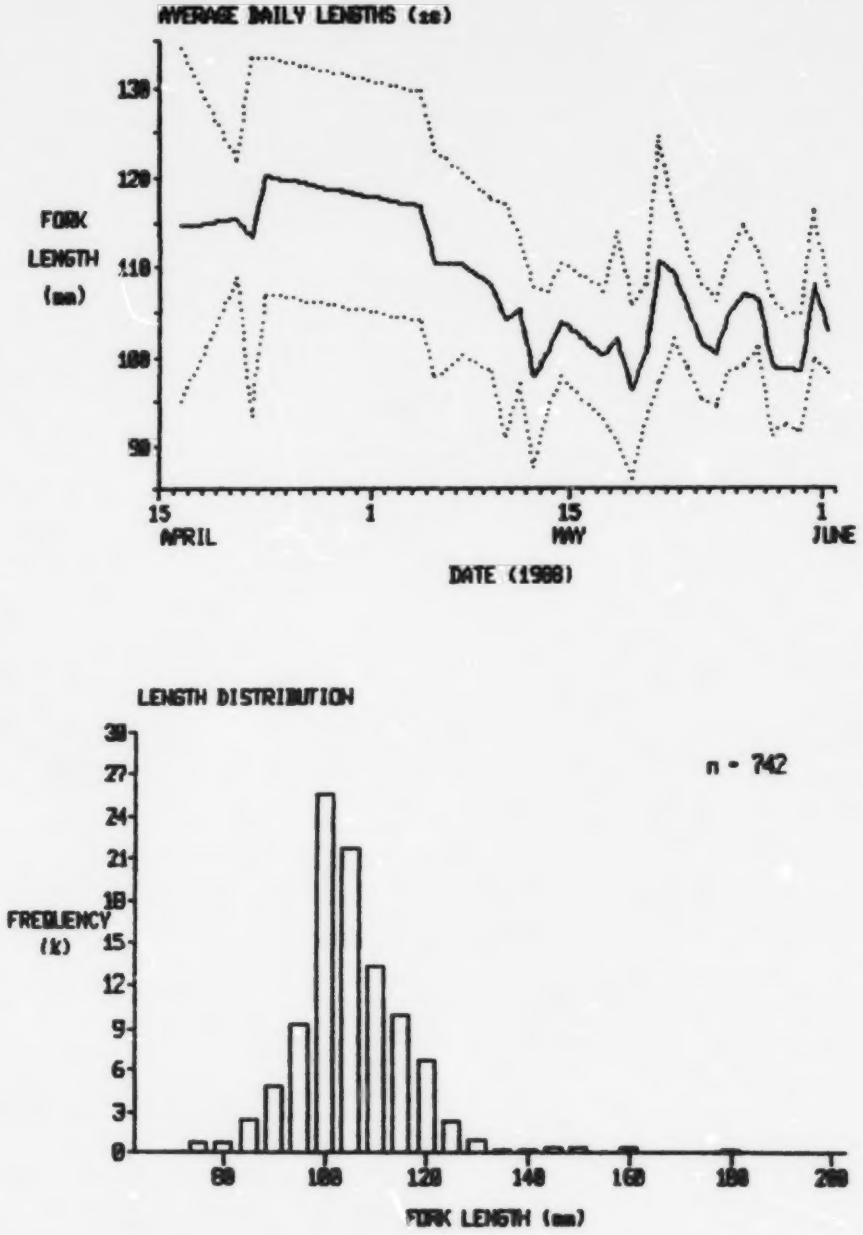
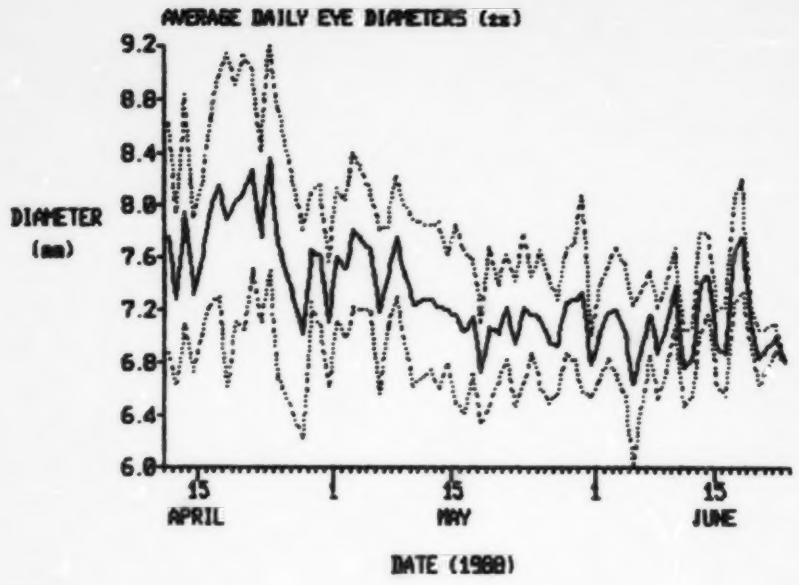


Figure 11
Average daily nose-fork lengths (± s) and length-frequency distributions of Trent River coho smolts.



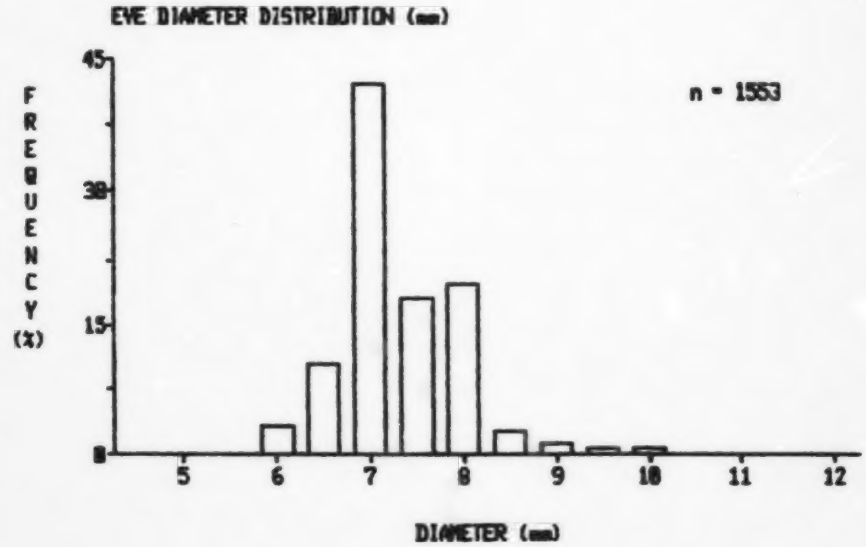


Figure 12
Average daily eye diameters (± s) and eye diameter-frequency distributions of Black Creek coho smolts.

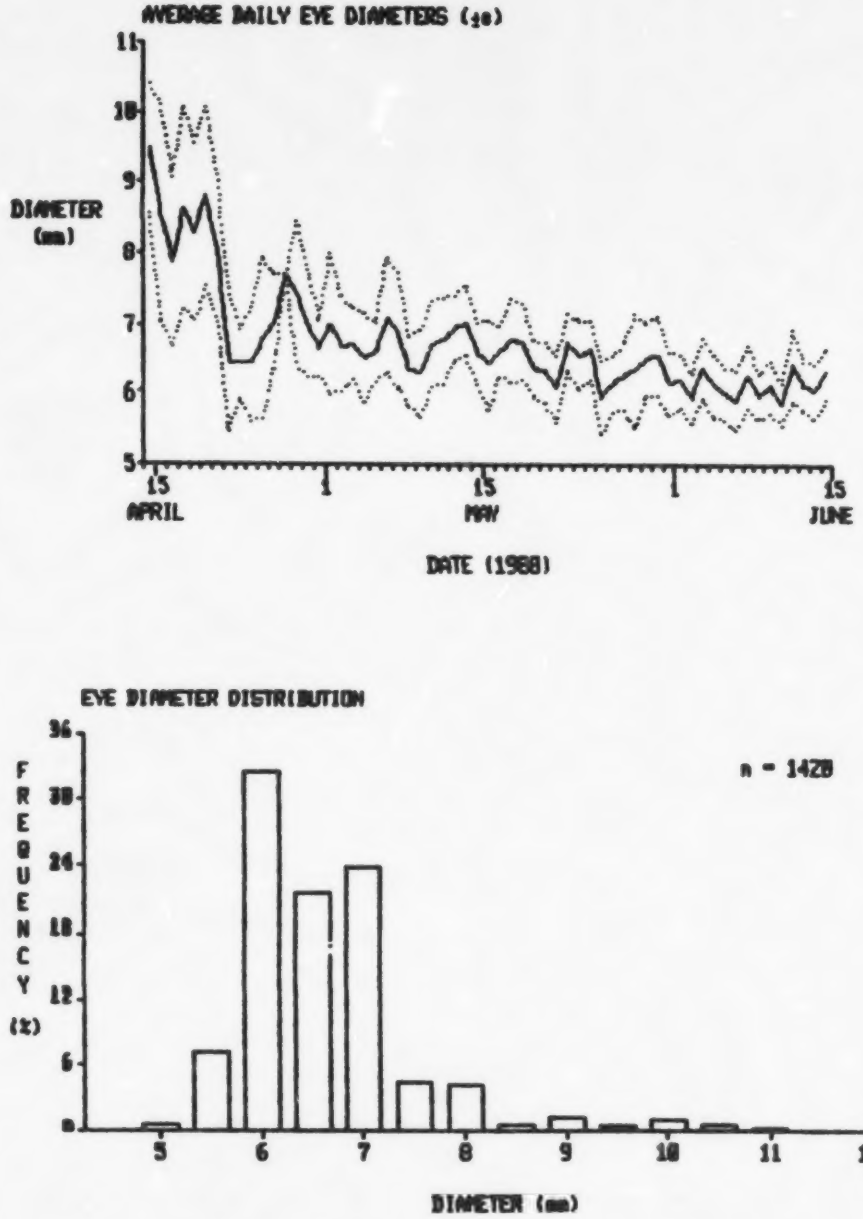


Figure 13
Average daily eye diameters (± s) and eye diameter-frequency distributions of French Creek coho smolts.

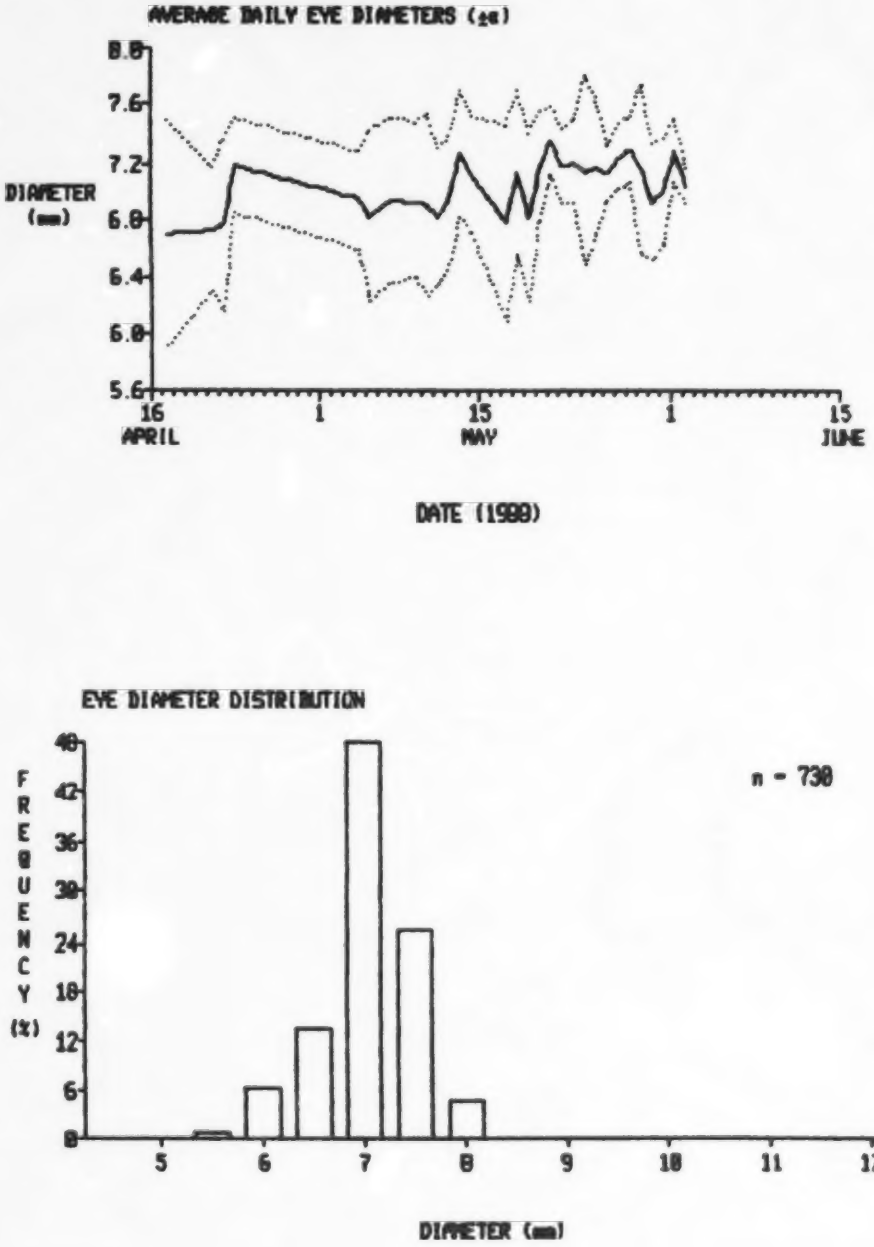


Figure 14
Average daily eye diameters (± s) and eye diameter-frequency distributions of Trent River coho smolts.

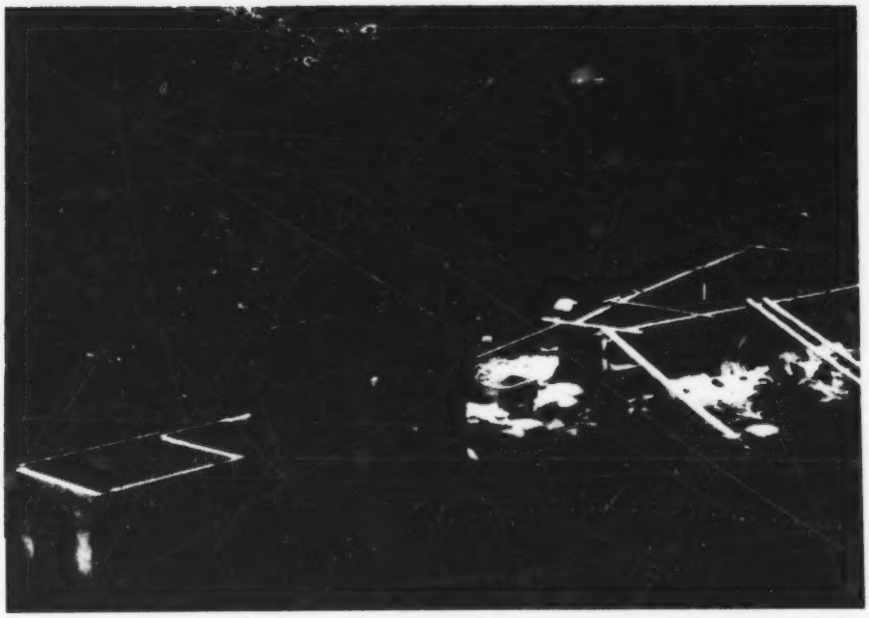


Photo 1. The Black Creek juvenile enumeration fence.

Photo 2. The French Creek juvenile enumeration fence.

Photo 3. The juvenile enumeration fence on the south branch of the Trent River.

Appendix 1. Black Creek, French Creek and Trent River hydrology and weather data for April to June, 1988.

Black Creek

Date	Time	Temperature (oC) Min	Max	Present	Depth (cm) gauge 1*	Depth (cm) gauge 2**	Rain	Wind	% cloud
April 10	08:00	6.0	10.0	7.0		88.0	1		
11	08:00	6.0	8.0	7.0		90.0	1		
12	08:00	6.0	8.0	7.0		90.0	1		
13	08:00	6.0	9.0	8.0		90.0	1		
14	07:00	8.0	12.0	9.0			1		
15	08:00	5.0	8.0	7.0	57.5	90.0	1		
16	08:00	6.0	12.0	7.0	55.0	87.0	1		
17	08:00	6.0	12.0	7.0	55.0	87.0	1		
18	08:00	6.0	11.0	8.0	52.5	85.0	1		
19	08:00	6.0	10.0	7.0	51.0	83.0	1		
20	08:00	6.0	10.0	6.0	50.0	82.0	1		
21	08:00	8.0	12.0	10.0	47.5	80.0	1		
22	08:00	8.5	12.5	10.5	47.5	80.0			
23	08:00	7.0	12.0	10.0	45.0	80.0	3		
24	08:00	7.0	13.0	9.0	46.0	80.0	1		
25	08:00	7.0	12.0	9.0	46.0	80.0	1		
26	09:30	8.5	11.5	8.5	45.1	73.7	1		
27	08:00	8.5	10.0	13.0	45.1	76.2	3		
28	08:00	10.0	13.0	12.0	50.0	80.0	4		
29	08:00	8.0	12.5	9.0	50.0	80.0	3		
30	07:50	9.0	12.0	9.0	54.0	87.6	1		
May 1	08:00	7.0	9.5	7.0	54.0	80.0	1		
2	08:00	7.0	9.0	8.0	55.0	87.0	3	light SE	80
3	08:00	8.0	11.5	11.0	58.0	90.0	1	0	20
4	08:30	8.5	10.0	8.5	54.6	91.4	1		
5	07:30	8.5	11.5	10.0	52.1	82.5	1		
6	08:00	10.0	13.5	11.0	50.0	75.0	3	0	100
7	07:40	9.5	13.0	9.5	48.9	76.8			
8	08:00	9.5	14.0	10.5	47.6	74.9			
9	08:00	10.5	15.0	11.5	45.7	70.5			
10	08:00	11.0	15.0	13.0	45.0	70.0	1	0	100
11	08:00	11.0	14.0	11.5	42.0	65.0	3	0	100
12	08:00	11.5	15.0	12.0	42.0	65.0	3	0	100
13	08:00	12.5	15.0	13.0	42.0	65.0	3	0	90
14	07:30	11.5	14.0	11.5	42.0	65.0	1	0	20
15	08:00	10.0	12.0	11.0	45.0	70.0	4	SE	100
16	08:30	11.5	12.5	12.0	51.4	70.5	1	0	100
17	07:15	11.5	14.0	11.5	50.2	76.8	1	0	100
18	07:30	11.0	13.0	10.5	47.5	72.5	1	0	100
19	08:00	10.0	12.5	11.0	47.5	72.5	1	0	80
20	07:40	10.5	13.0	10.5	47.0	70.5	1	0	0
21	08:00	10.5	15.0	12.0	45.1	67.3	1	0	40
22	08:00	12.0	15.0	13.5	45.7	66.0	4	0	100
23	08:00			13.0	45.7	66.0	1	0	70
24	08:30			10.5	45.7	66.0	1	0	0
25	09:00	10.5	14.0	12.0	43.2	67.3	1	5 SE	50
26	08:00	12.0	13.5	15.0	41.3	62.9	1	0	80

Appendix 1. Black Creek, French Creek and Trent River hydrology and weather data for April to June, 1988.

Black Creek

Date	Time	Temperature (oC) Min	Max	Present	Depth (cm) gauge 1*	Depth (cm) gauge 2**	Rain	Wind	% cloud
May 27	07:30	12.0	12.5	14.5	41.3	61.6	4	10-15 SE	100
28	08:40	11.0	14.0	11.0	42.5	63.5	1	0	80
29	08:20	10.5	13.0	10.5	47.0	70.5	1	0	80
30	08:00	11.0	13.5	10.5	45.7	67.3	1	5 W	50
31	07:30	11.0	13.0	10.0	43.8	66.0	1	10 NW	70
June 01	07:15	11.0	13.5	11.0	42.5	62.9	4	0	100
2	08:20	10.0	10.0	12.5	41.9	59.7	5	25	100
3	08:00	10.0	11.0	10.0	59.1	86.4	1	0	90
4	08:00	9.5	12.0	10.5	55.9	81.3	1	0	0
5	08:00	10.0	12.0	10.0	53.3	80.0	1	0	0
6	08:00	10.0	14.5	11.0	50.8	76.2	3	0	100
7	08:00	10.5	12.5	10.5	49.5	73.7	1	0	90
8	07:30	10.5	14.0	12.0	47.0	68.6	1	0	90
9	08:00	11.0	14.5	11.0	45.1	66.0	1	0	0
10	08:00	11.0	15.5	13.0	43.2	62.2	1	2 SE	100
11	08:00	13.0	15.0	14.0	47.0	73.7	1	0	10
12	08:00	13.0	17.0	15.0	45.7	71.8	1	0	0
13	08:00	13.0	16.0	13.0	43.8	68.6	1	0	0
14	08:00	13.0	17.0	13.5	42.6	64.1	1	0	0
15	08:30	13.5	18.0	15.5	40.6	62.2	1	0	0
16	08:30	15.0	19.0	15.0	40.0	66.0	1	0	80
17	09:00	15.0	16.5	15.0	38.1	63.5	2	0	100
18	10:00	14.0	15.5	14.0	37.5	61.0	1	5	60
19	09:00	13.5	16.5	14.0	36.8	61.0	1	0	30
20	09:00	13.5	16.5	13.5	35.6	56.5	1	0	40
21	09:00	14.0	18.0	15.0	34.9	53.3	1	0	90
22	09:00	13.5	18.0	14.0	34.3	52.1	1	0	90
23	09:00	14.0	19.0	15.0	33.0	49.5	1	0	100
24	08:00	14.5	19.0	15.0	33.0	48.3	1	0	50

* - staff gauge 200 m above fence ** - staff gauge at bridge

Appendix 1. Black Creek, French Creek and Trent River hydrology and weather data for April to June, 1988.

French Creek

Date	Time	Temperature (oC) Min	Max	Present	Depth* (m) gauge 1	Depth** (m) gauge 2	Rain	Wind (km)	% cloud
April 10									
11									
12									
13	08:00	8.0	10.0		0.39				
14	08:00	7.0	9.0		0.43				
15	08:30	8.0	11.0		0.44				
16	09:00	7.0	9.0		0.42				
17	08:00	8.0	10.0		0.42				
18	08:00	7.0	9.0		0.40				
19	07:46	6.0	10.0		0.38				
20	07:45	7.0	10.0		0.37				
21	10:12	8.0	10.0	8.0	0.42				
22	09:45	8.5	10.0	9.0	0.45	0.47			
23	10:53	8.0	10.0	8.0	0.37		3	SE 5	100
24	08:30	6.5	9.0	6.5	0.36		1	0	40
25	07:30	6.0	8.0	6.0	0.32	0.50	1	SE 5	100
26	07:00	7.0	8.0	6.0	0.29	0.45	1	0	5
27	07:00	6.0	8.0	8.0	0.29	0.45	2	0	100
28	07:00	7.0	9.5	8.5	0.30	0.45	2	0	100
29	07:00	8.0	10.0	7.5	0.50	0.60	1	0	100
30	06:00	6.0	11.0	8.0	0.36	0.50	2	0	100
May 1	07:30	5.5	10.0	6.5	0.35	0.50	1	SE 5	10
2	07:30	6.0	7.0	7.0	0.33	0.48	3	SE 15	100
3	06:30	6.0	7.0	7.0	0.36	0.50	2	0	10
4	06:30	6.0	7.0	7.0	0.34	0.48	1	5	100
5	07:30	5.0	9.5	7.0	0.32	0.47	1	5	20
6	07:30	7.0	10.0	8.0	0.32	0.48	2	0	90
7	06:30	5.0	10.0	7.0	0.31	0.47	1	0	0
8	06:30	7.0	8.0	8.0	0.32	0.46	1	5	0
9	07:30	5.0	12.0	10.0	0.31	0.46	2	0	100
10	07:30	10.0	11.0	10.0	0.31	0.46	2	0	100
11	07:30	10.0	11.5	10.0	0.31	0.46	2	0	90
12	07:30	11.0	12.0	11.0	0.32	0.48	2	0	80
13	07:30	11.0	13.0	11.0	0.38	0.50	4	0	100
14	07:30	9.5	12.0	9.5	0.33	0.48	1	0	5
15	07:30	10.0	11.0	10.0	0.30	0.45	3	0	100
16	07:30	10.0	11.0	10.0	0.30	0.46	1	0	100
17	07:30	11.0	12.0	11.0	0.32	0.48	1	0	90
18	07:30	9.0	12.0	11.0	0.32	0.47	1	SE 15	100
19	07:30	9.0	10.0	9.5	0.30	0.46	1	SE 10	80
20	07:30	7.5	11.0	8.0	0.29	0.44	1	SE 3	0
21	07:30	9.5	11.5	9.5	0.27	0.43	1	0	0
22	07:30	9.5	13.0	12.0	0.26	0.42	1	0	100
23	07:30	10.0	12.0	10.0	0.27	0.43	1	SE 10	40
24	07:30	7.5	11.5	8.0	0.25	0.41	1	SE 5	5
25	07:30	7.0	12.0	10.0	0.24	0.40	1	0	75
26	07:30	9.5	12.5	10.5	0.23	0.39	1	0	100

Appendix 1. Black Creek, French Creek and Trent River hydrology and weather data for April to June, 1988.

French Creek

Date	Time	Temperature (oC) Min	Max	Present	Depth* (m) gauge 1	Depth** (m) gauge 2	Rain	Wind (km)	% cloud
May 27	07:30	10.5	11.5	10.5	0.24	0.39	2 SE 10		90
28	07:30	9.5	12.0	10.0	0.24	0.40	1	0	20
29	07:30	10.0	12.5	10.0	0.26	0.42	1	0	10
30	07:30	9.0	12.5	9.0	0.24	0.40	1	0	40
31	07:30	9.0	11.0	10.0	0.24	0.39	2	5	100
June 01	07:30	9.5	12.5	9.5	0.23	0.38	3 SE 5		95
2	07:30	10.0	10.5	10.0	0.23	0.38	1	0	
3	07:30	9.0	10.0	9.0	0.30	0.45	2 W 15		60
4	07:30	8.5	11.0	8.5	0.31	0.47	1	0	20
5	07:30	8.5	10.5	8.5	0.28	0.44	1 W 3		0
6	07:30	10.0	12.0	10.0	0.26	0.42	1	0	100
7	07:30	9.5	11.5	10.5	0.29	0.44	1	0	100
8	07:30	9.0	11.5	10.0	0.27	0.43	1 SE 10		90
9	07:30	9.5	13.0	9.5	0.26	0.41	1 SE 5		0
10	07:30	8.0	13.0	11.5	0.24	0.40	2	0	100
11	07:30	11.5	13.5	11.5	0.24	0.39	1	5	100
12	07:30	11.0	14.0	11.0	0.23	0.39	1	5	0
13	07:30	11.0	15.0	12.0	0.22	0.38	1	0	0

* - staff gauge above fence ** - staff gauge below fence

Appendix 1. Black Creek, French Creek and Trent River hydrology and weather data for April to June, 1988.

Trent River

Date	Time	Temperature (oC) Min	Max	Present	Depth (m)	Rain	Wind	% cloud
April 15	08:45			6.0	0.65	1		
16	08:00	6.0	6.5	9.0	0.64	1		100
17	08:30	6.0	6.5	8.0	0.63	1		100
18	08:30	6.0	8.0	7.0	0.60	1	0	5
19	08:30	6.0	9.0	7.0	0.57	1	0	5
20	08:30	6.0	9.0	7.0	0.56	1	0	0
21	08:30	6.0	9.0	7.0	0.55	1	0	0
22	08:30	6.0	9.0	7.0	0.54	1	0	0
23	08:30	6.0	9.0	7.0	0.53	1	0	0
24	08:30	6.0	10.0	7.0	0.52	1	0	5
25	08:30	6.5	8.0	6.0	0.49	1	0	10
26	08:30	5.0	8.0	6.0	0.48	1	SE Light	20
27	08:30	6.0	10.0	7.0	0.50	2	0	100
28	08:30	6.0	8.0	5.5	0.79	3	S Light	50
29	14:00	5.5	8.0	6.0	0.68	3	SW Strong	50
30	08:30	6.0	8.0	6.0	0.60	1	Light	10
May 1	08:30	5.0	8.0	5.0	0.56	1	NW Light	30
2	08:30	5.0	8.0	6.0	0.55	2	SE Light	80
3	08:30	6.0	7.5	7.0	0.55	1	SE Light	60
4	08:30	6.0	8.0	6.5	0.54	1	0	60
5	08:30	7.0	9.0	7.0	0.53	1	NW Light	10
6	08:30	5.5	8.0	7.0	0.54	1	NW Light	75
7	08:30	5.5	9.0	6.5	0.53	1	SW Light	0
8	08:30	6.0	9.0	6.0	0.55	1	0	0
9	08:30	6.0	9.0	6.5	0.56	1	0	100
10	08:30	8.0	11.0	8.0	0.57	1	0	100
11	08:30	9.0	10.0	10.0	0.58	1	NE	80
12	08:30	10.5	14.5	10.5	0.60	1	SW Light	80
13	08:30	8.0	14.5	8.5	0.65	3	NW Mod.	100
14	08:30	8.0	14.0	8.0	0.52	1	SE Light	20
15	08:30	8.0	12.0	8.0	0.52	2	SE Light	100
16	08:30	8.0	10.0	8.0	0.65	1	SW Light	100
17	08:30	5.5	12.5	6.5	0.66	1	SW Light	90
18	08:30	5.5	12.0	6.5	0.64	1	NW Light	100
19	08:30	7.0	12.0	9.0	0.56	1	SE	60
20	08:30	5.5	10.0	7.0	0.56	1	SE	10
21	08:30	8.0	12.0	9.0	0.54	1	0	10
22	08:30	9.0	13.0	10.0	0.54	3	0	100
23	08:30	8.5	12.0	9.0	0.54	1	SE Light	60
24	08:30	5.0	9.5	7.0	0.49	1	0	0
25	08:30	5.0	11.5	9.0	0.48	1	SW Light	60
26	08:30	10.0	12.0	10.0	0.48	1	0	100
27	08:30	10.0	12.0	9.5	0.48	2	SW Light	100
28	08:30	8.0	10.0	10.0	0.63	1	0	20
29	08:30	5.0	11.0	7.5	0.57	1	SE Light	10
30	08:30	5.0	10.5	7.0	0.51	1	SE Light	100
31	08:30	4.5	10.5	9.0	0.49	1	SE Light	100
June 01	08:30	9.0	12.0	8.0	0.49	1	0	100
2	08:30	9.0	12.0	9.0	0.47	2	0	100
3					0.90			
4	08:30	6.5	10.5	9.0	0.68	1	NW Light	0

Appendix 2. Black Creek, French Creek and Trent River daily trap catches for April to June, 1988.

Black Creek

Date	Coho total catch	Coho escapees releases	1* tagged morts.	2** tagged morts.	Trap & hold morts.	Large tagged	Small tagged	Coho fry
April 11	36	0	3	0	0	25	8	0
12	68	4	0	0	0	30	34	0
13	19	0	0	0	3	10	6	0
14	17	0	0	0	1	9	7	0
15	11	0	0	0	0	6	5	0
16	24	0	0	0	0	22	2	0
17	51	0	0	0	2	42	7	0
18	66	0	0	0	2	48	16	0
19	36	0	1	0	0	31	4	0
20	91	0	0	0	0	80	11	0
21	39	0	0	0	0	33	6	0
22	102	0	0	0	0	87	15	0
23	93	0	2	0	0	72	19	0
24	338	0	0	0	0	288	50	0
25	87	1	0	0	0	83	3	0
26	704	0	0	0	0	575	129	0
27	126	0	2	0	12	83	29	0
28	285	0	1	0	1	250	33	0
29	2,276	23	1	0	0	2,128	124	0
30	892	11	0	0	2	742	137	0
May 01	474	4	0	0	0	397	73	0
2	156	26	0	0	0	110	20	0
3	1,571	4	1	0	0	1,449	117	0
4	2,011	15	4	0	2	1,607	383	0
5	979	2	0	0	8	740	229	0
6	1,190	0	0	0	6	816	368	0
7	1,273	32	1	0	6	811	423	0
8	1,831	27	1	0	0	1,142	661	0
9	2,167	0	0	0	8	1,355	804	0
10	4,851	5	0	0	0	2,988	1,858	0
11	2,211	5	0	0	0	1,501	705	0
12	4,857	0	4	0	7	1,975	2,871	0
13	1,321	500	0	0	5	506	310	0
14	1,819	5	0	0	0	660	1,154	0
15	1,804	3	0	0	3	178	1,620	0
16	9,868	25	0	14	4	1,985	7,854	0
17	2,190	36	0	0	14	377	1,763	0
18	2,543	6	0	0	0	200	2,337	1
19	2,980	16	0	0	0	241	2,723	1
20	1,730	6	1	3	0	113	1,610	0
21	1,601	3	3	0	0	130	1,465	1
22	847	6	0	0	4	48	789	1
23	4,614	18	0	0	5	441	4,150	0
24	539	2	0	0	6	21	510	2
25	1,634	7	0	3	9	100	1,518	0
26	277	1	0	0	2	14	260	1

Appendix 2. Black Creek, French Creek and Trent River daily trap catches for April to June, 1988.

Black Creek

Date	Coho total catch	Coho escapees releases	1* tagged morts.	2** tagged morts.	Trap & hold morts.	Large tagged	Small tagged	Coho fry
May 27	213	1	0	0	0	6	206	0
28	1,359	86	0	0	0	78	1,195	2
29	4,267	28	1	8	14	688	3,536	2
30	1,041	13	0	0	0	141	887	1
31	559	7	0	0	0	30	522	0
June 01	512	33	0	0	2	16	461	0
2	2,393	0	0	0	0	433	1,960	0
3	833	13	0	0	0	192	628	0
4	615	2	0	0	2	68	543	0
5	448	0	0	0	2	17	429	0
6	259	1	1	0	3	10	244	1
7	226	0	2	6	8	3	213	1
8	256	0	0	0	0	1	255	0
9	149	0	0	0	0	2	147	0
10	74	0	0	0	0	0	74	0
11	118	0	0	0	0	2	116	1
12	206	2	0	1	0	3	201	0
13	27	0	0	1	1	2	24	0
14	40	0	0	0	2	0	38	1
15	22	0	0	0	0	0	22	0
16	17	0	0	0	0	2	15	0
17	53	0	0	0	0	2	51	0
18	5	0	0	0	0	0	5	0
19	7	0	0	0	0	0	7	0
20	2	0	0	0	0	0	2	0
21	0	0	0	0	0	0	0	0
22	3	3	0	0	0	0	0	0
23	1	1	0	0	0	0	0	1
24	0	0	0	0	0	0	0	0
sum	76,404	983	29	36	146	26,245	49,001	17

1* Tagged coho that died during the tagging process.
2** Tagged coho that died during holding after tagging.

Appendix 2. Black Creek, French Creek and Trent River daily trap catches for April to June, 1988.

Black Creek

Date	Rainbow parr	Steelhead smolts	Steelhead kelts	Cut. parr	Cut. smolts	Cut. adults	Cottids	Lamp.	Stickleback
April 11	0	0	0	0	0	2	0	0	4
12	0	0	0	0	0	3	36	0	0
13	0	0	1	1	0	8	43	0	6
14	0	0	1	0	0	10	32	0	4
15	1	0	1	0	0	11	46	0	5
16	1	0	2	0	0	8	33	1	2
17	0	3	0	0	3	8	31	0	0
18	0	1	0	0	0	10	54	0	2
19	0	2	0	1	0	6	29	0	1
20	0	6	0	1	0	20	26	0	1
21	0	1	1	0	0	6	9	0	2
22	0	12	0	1	0	8	18	0	1
23	0	7	0	0	0	8	10	0	0
24	0	1	0	1	0	1	4	0	1
25	0	0	0	0	0	0	4	1	0
26	0	1	0	0	0	7	7	0	0
27	0	1	0	0	0	0	5	0	0
28	0	38	3	2	0	24	5	2	5
29	0	0	3	0	0	0	0	0	0
30	0	8	0	1	0	6	1	0	6
May 01	0	0	0	0	0	0	5	1	0
2	0	9	1	1	0	1	2	0	1
3	0	46	3	3	0	4	5	0	1
4	0	0	0	0	0	11	5	0	0
5	0	0	0	0	0	1	10	0	0
6	0	0	0	0	0	0	2	0	2
7	0	0	0	0	3	1	7	0	0
8	0	0	0	0	0	0	5	0	0
9	0	0	1	0	0	4	15	0	0
10	0	1	0	0	0	3	8	1	1
11	0	7	0	3	0	3	10	0	3
12	0	9	0	4	0	10	0	1	0
13	0	7	0	2	0	3	10	0	2
14	0	0	0	0	0	0		0	0
15	0	0	0	0	0	0		0	0
16	0	1	0	0	0	0	5	0	5
17	0	1	0	0	0	0	5	1	0
18	0	7	0	1	0	1	10	0	3
19	0	3	0	1	0	0	10	0	4
20	0	0	0	0	0	0	3	0	2
21	0	1	0	0	0	1	5	0	3
22	0	0	0	0	0	0	9	0	4
23	0	1	0	0	0	0	0	0	1
24	0	0	0	0	0	0	0	0	2
25	0	0	0	0	0	0	1	1	0
26	0	0	0	0	0	0	5	0	2

Appendix 2. Black Creek, French Creek and Trent River daily trap catches for April to June, 1988.

Black Creek

Date	Rainbow parr	Steelhead smolts	Steelhead kelts	Cut. parr	Cut. smolts	Cut. adults	Cottids	Lamp.	Stickleback
May 27	0	0	0	0	0	0	2	0	0
28	0	0	0	0	0	0	3	0	1
29	0	0	0	0	0	1	2	0	0
30	0	3	0	0	1	0	4	1	1
31	0	6	0	0	1	0	3	0	1
June 01	0	0	0	0	0	1	0	0	1
2	0	0	0	0	0	0	0	0	0
3	0	26	5	0	0	8	12	1	5
4	0	0	0	0	0	1	0	0	0
5	0	2	0	2	0	0	4	2	5
6	0	0	0	0	0	0	12	0	1
7	0	0	0	0	0	0	2	0	0
8	0	0	0	0	0	0	6	0	3
9	0	0	0	0	0	0	1	0	0
10	0	3	10	0	0	1	2	0	0
11	0	0	0	0	0	0	6	0	3
12	0	0	0	0	0	0	7	1	2
13	0	0	0	0	0	0	0	0	1
14	0	0	0	0	0	0	2	0	0
15	0	0	0	1	0	0	14	0	5
16	0	0	0	0	0	0	21	0	3
17	0	0	0	0	0	0	4	1	0
18	0	0	0	0	0	0	3	1	0
19	0	0	0	0	0	0	8	0	1
20	0	0	0	0	0	0	6	1	1
21	0	0	0	0	0	0	4	1	1
22	0	0	0	0	0	0	1	0	0
23	0	0	0	0	0	0	2	0	1
24	0	0	0	0	0	0	0	0	1
sum	2	214	32	26	8	201	661	18	113

Appendix 2. Black Creek, French Creek and Trent River daily trap catches for April to June, 1988.

French Creek

Date	Total coho smolts	Released-escapees	Tag mort.	Trap & holding mort.	Number tagged	Coho parr	Rainbow parr	Steelhead smolts	Steelhead mature adults	Steelhead spent adults
April 13	0	0	0	0	0	0	0		0	0
14	6	0	0	0	0	0	11		0	0
15	20	0	0	0	0	0	15		0	0
16	26	0	0	0	0	0	8		0	0
17	17	8	1	1	59	0	11		0	0
18	11	0	0	0	0	0	8		0	1
19	32	0	0	0	0	0	11	21	0	0
20	28	1	0	0	70	0	5	10	0	0
21	28	0	0	0	0	0	3	9	0	0
22	51	0	0	3	76	0	9	28	1	0
23	38	0	0	0	0	0	9	8	0	1
24	13	2	2	0	47	0	4	22	0	0
25	17	0	0	0	0	0	0	5	0	0
26	1	0	0	0	0	0	0	0	0	0
27	32	0	0	0	0	3	0	15	0	1
28	15	2	0	0	63	2	0	11	2	2
29	88	0	0	15	0	0	0	42	0	1
30	30	0	0	0	103	0	0	16	2	0
May 1	77	0	0	0	0	0	0	11	0	0
2	34	0	1	0	110	0	0	3	0	0
3	33	0	0	0	0	0	0	4	1	0
4	52	0	1	9	75	0	0	7	0	0
5	104	0	0	0	0	1	1	18	0	0
6	47	0	0	0	0	0	0	3	0	0
7	45	0	0	0	0	0	4	5	0	0
8	162	4	0	0	354	1	15	32	0	2
9	125	0	0	0	0	1	6	10	0	0
10	256	0	3	1	377	0	7	41	0	1
11	130	0	0	0	0	0	1	4	0	0
12	481	0	0	0	0	0	9	16	0	0
13	977	25	16	13	1,534	0	13	119	0	6
14	276	25	0	5	0	0	1	6	0	0
15	255	25	0	1	0	0	0	3	0	0
16	673	25	2	9	1,112	0	9	11	0	0
17	590	25	0	0	0	1	0	12	0	1
18	436	24	0	0	977	0	5	10	0	0
19	498	25	0	0	0	0	3	18	0	2
20	1,285	25	2	2	1,729	0	10	16	0	0
21	624	25	1	1	597	1	5	10	0	0
22	2,310	25	0	0	0	0	19	68	0	0
23	1,746	25	3	3	4,000	1	14	73	0	2
24	885	25	2	0	858	0	12	21	0	0
25	966	28	8	0	930	1	18	33	0	1
26	953	25	0	0	0	0	0	25	0	0
27	1,377	28	1	1	2,275	0	1	37	0	0
28	1,342	29	0	0	0	0	8	47	0	1
29	939	37	0	2	2,213	0	5	18	0	0
30	1,457	25	0	3	1,429	1	5	16	0	2
31	1,275	47	8	3	1,217	0	0	8	0	0
June 01	1,001	25	0	0	0	3	2	8	0	1
2	385	37	0	1	1,323	1	3	4	0	0
3	1,396	25	0	1	0	17	8	68	1	10
4	1,541	47	0	0	2,864	42	9	37	0	1
5	377	27	0	0	0	18	2	5	0	0
6	214	26	0	0	538	3	1	1	0	0
7	543	25	0	0	0	3	2	2	0	2
8	330	36	6	7	807	3	3	0	0	0
9	322	25	0	0	0	26	3	2	0	0
10	66	0	0	0	363	6	1	1	0	0
11	148	0	0	0	0	2	0	2	0	1
12	196	0	0	0	0	7	1	1	0	0
13	178	0	0	4	518	2	0	0	0	0
sum	27,560	800	57	85	26,618	146	247	1,076	7	32

Appendix 2. Black Creek, French Creek and Trent River daily trap catches for April to June, 1988.

French Creek

Date	Cut. parr	Cut. smolts	Cut. adults	Cutts.	Trout parr	Trout smolts	Cottids	Lamprey	Stickle-back	Chum
April 13				0	5		14	0	0	0
14				12	0		21	0	0	0
15				18	0		25	0	0	0
16				12	0		17	0	0	0
17				12	0		18	0	0	0
18	14	0	0		0		16	0	1	0
19	6	15	3		0		2	0	0	0
20	7	3	0		0		11	0	0	0
21	4	3	9		11		11	0	0	0
22	5	0	3		6		5	0	0	0
23	0	0	3		3		8	0	0	0
24	0	0	2		4		15	0	0	0
25	0	0	0		3	5	3	0	0	0
26	0	0	0		0	0	0	0	0	0
27	0	0	0		7	0	7	0	0	0
28	0	0	0		9	0	4	0	0	0
29	0	3	3		5	12	11	0	0	0
30	0	1	0		2	1	7	0	0	0
May 1	0		0		7		3	1	1	0
2	1		0		1		3	0	0	0
3	3		0		0		2	0	0	0
4	1		0		2		5	1	0	0
5	4		0		2		5	2	0	0
6	2		0		2		2	0	0	0
7	1		1		0		4	0	0	0
8	2		0		2		3	0	1	0
9	2		0		1		5	0	1	0
10	5		0		1		3	0	0	0
11	0		2		1		4	0	0	0
12	1		0		5		4	0	0	0
13	16		1		5		4	0	0	0
14	4		4		3		0	0	1	0
15	3		0		2		0	0	0	0
16	4		0		0		0	0	1	0
17	1		0		2		1	0	0	0
18	2		0		2		1	0	0	0
19	7		0		2		4	0	0	0
20	5		0		2		3	0	0	1
21	2		0		1		1	0	0	0
22	6		1		4		3	1	0	0
23	6		0		21		0	1	0	0
24	9		0		3		0	1	1	1
25	1		0		1		2	0	0	1
26	0		0		4		2	0	0	0
27	0		0		18		1	0	0	0
28	1		0		12		0	1	1	0
29	3		0		8		2	0	0	0
30	5		0		3		0	0	0	0
31	2		0		10		1	0	0	0
June 01	6		0		7		1	0	0	0
2	2		1		2		0	0	0	0
3	10		3		15		1	0	0	0
4	22		0		24		0	0	0	0
5	4		0		2		5	0	1	0
6	2		0		4		2	0	0	0
7	1		0		6		1	0	1	0
8	3		0		0		0	0	1	0
9	4		0		3		0	0	0	0
10	0		0		0		0	0	1	0
11	2		0		2		1	0	0	0
12	0		0		1		0	0	0	0
13	0		0		4		0	0	0	0
sum	191	25	36	54	252	18	284	8	12	3

Appendix 2. Black Creek, French Creek and Trent River daily trap catches for April to June, 1988.

Trent River

Date	Hrs. op.	Coho smolts total	Releases	Marks	Tagged coho	Coho parr	Coho fry	Marks upper caudal
April 16	12*	4	0	0		0	0	0
17	24*	9	0	0		0	0	0
18	24*	14	4	0	23	0	0	0
19	24*	4	0	0		0	0	0
20	24*	0	0	0		0	0	0
21	24	8	4	0	8	0	0	0
22	24	63	2	0	61	3	0	0
23	24	26	0	0	26	2	0	0
24	24	20	0	0		0	0	0
25	24	46	0	0	66	0	0	0
26	24	20	19	0		0	0	0
27	24	34	0	0		0	0	0
28	12	-	0	-		-	-	-
29	0	-	0	-		-	-	-
30	0	-	0	-		-	-	-
May 1	12*	5	0	0		20	0	0
2	24	31	0	13		0	0	0
3	24	42	0	7		3	6	0
4	24	44	0	14	123	0	0	0
5	24	197	0	0	197	0	0	0
6	24	570	0	0	570	0	1	0
7	24	271	0	0		0	3	0
8	24	160	0	6	425	6	0	0
9	24	702	0	12	690	0	0	0
10	24	144	0	1	143	0	6	0
11	24	106	0	1	105	2	2	0
12	24	775	0	21	754	0	5	0
13	16	1,281	0	0	1,281	0	3	0
14	24	592	0	32	560	0	4	0
15	24	801	0	37	764	0	0	0
16	16	421	0	20	401	0	0	0
17	24	147	0	2	145	0	4	0
18	24	386	0	2	384	0	3	0
19	24	1,374	0	4	1,370	0	6	rel.
20	24	1,056	0	0	1,056	1	1	1
21	24	868	0	0	868	0	0	50
22	24	1,135	0	1	1,134	0	0	15
23	24	1,270	0	1	1,269	0	0	7
24	24	376	0	1	375	2	1	0
25	24	826	0	3	823	0	1	0
26	24	876	0	0	876	0	0	2
27	24	503	0	0	503	0	0	1
28	24	1,673	0	0	1,673	0	0	0
29	24	1,151	0	10	1,141	1	3	0
30	24	151	0	3	148	7	7	0
31	24	222	0	0		0	0	0
June 1	24	200	0	0		0	0	0
2	24	100	0	0	522	0	0	0
3	0	-	-	-		-	-	-
4	0	-	-	-		-	-	-
5	0	-	-	-		-	-	-
6	0	-	-	-		-	-	-
Sum		18,704	29	191	18,484	47	56	76

* - only one of the two traps in operation

Appendix 2. Black Creek, French Creek and Trent River daily trap catches for April to June, 1988.

Trent River

Date	Marks upper caudal	Rain. parr	Rain. smolts	Rain. mature adults	Rain. spent adults	Cut. parr	Cut. smolts	Trout parr	Cottid	Stickle-back	Chum parr
April 16	0	0	1	0	0	0	0	0	28	0	0
17	0	0	0	0	0	0	0	3	19	0	0
18	0	0	2	0	0	0	0	0	9	0	0
19	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	1	0	1	0	0	0	0
21	0	0	0	0	0	0	1	2	13	0	0
22	0	0	1	0	0	0	0	0	18	0	0
23	0	0	0	0	1	0	0	1	31	0	0
24	0	0	1	0	0	0	0	0	20	0	0
25	0	0	2	0	1	0	0	0	19	0	0
26	0	0	0	0	0	0	0	2	20	0	1
27	0	0	3	0	0	0	0	0	17	0	0
28	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-
May 1	0	2	2	0	0	0	0	0	10	0	0
2	0	0	0	0	0	0	0	0	7	0	0
3	0	1	0	0	0	0	0	0	8	0	0
4	0	0	1	0	0	0	0	0	11	0	0
5	0	1	9	0	0	0	1	0	17	0	1
6	0	0	19	0	0	0	0	0	31	0	0
7	0	2	27	0	2	0	0	0	40	0	10
8	0	0	20	0	1	0	0	0	18	0	5
9	0	0	25	0	1	0	0	0	35	0	0
10	0	0	15	0	1	0	0	0	20	0	5
11	0	4	50	0	3	0	1	0	23	0	3
12	0	4	50	0	2	0	0	0	37	0	35
13	0	0	20	0	0	0	0	0	11	1	150
14	0	0	20	0	0	0	0	0	15	0	200
15	0	2	25	0	0	0	0	0	13	0	150
16	0	0	10	0	0	2	0	0	10	0	200
17	0	0	4	0	0	0	0	0	7	0	2
18	0	1	11	0	0	1	1	0	12	0	250
19	rel.	1	33	0	0	1	0	0	16	0	150
20	1	3	56	0	0	1	0	0	19	0	100
21	50	5	63	0	2	0	1	0	15	0	0
22	15	0	65	0	0	0	0	0	10	0	75
23	7	1	104	0	2	3	3	0	10	0	75
24	0	1	20	0	0	0	0	0	9	0	2
25	0	6	52	0	1	6	1	0	11	0	10
26	2	25	59	0	2	0	1	0	5	0	0
27	1	3	27	0	0	0	0	0	2	0	20
28	0	21	84	0	0	0	0	0	5	0	50
29	0	10	53	0	0	2	1	0	15	0	75
30	0	0	0	1	6	1	0	0	5	0	32
31	0	0	6	0	0	0	0	0	1	0	17
June 1	0	5	13	0	0	0	0	0	6	0	30
2	0	4	13	0	0	0	0	0	4	0	20
3	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-
Sum	76	102	966	1	26	17	12	8	652	1	1,688

Appendix 3. Black Creek, French Creek and Trent River trap efficiency test data for 1988.

	Black Creek									French Creek		Trent R.
					Left		Right	Double		Upper		Upper
Date	Adipose	Rejects*	Caudal	Rejects	aax	Rejects	aax	caudal	Rejects	caudal	Rejects	caudal
April 25	released											
26	18											
27	2											
28	6											
29	49											
30	6											
May 1	2	1										
2	1											
3	8	1										
4	2	1										
5	0											
6	2	1										
7	0											
8	1											
9	1	1										
10	4	1										
11			released									
12			17									
13			16							released		
14			27									
15			7									
16			126	2						33	1	
17			37									
18			3							23		
19			3									released
20			12							35		1
21			26				released			4	1	50
22			8									15
23			37				15			42		7
24			0				1			10		0
25			1				4			4		0
26			1				2					2
27			9	1			4			5		1
28			19				43					0
29			3				0			6		0
30			2				2			1		0
31			0							1		0
June 01			0					released				
2			0							1		
3			12					58		1		
4			7				26	17		2		
5			1				4	4				
6							1					
7												
8												
9					released							
10					7							
11					2							
12					34	1						
13					0							
14					1							
15					1							
16					1							
17					5							
18					1							
19												
20												
21					1							
22												
23												
24												
sum	102	6	374	3	53	1	102	79	0	168	2	76
rejects	6		3		1	0		0		2		0
# released	100		400		100		100	100		200		100

* - rejects are coho that did not have a coded-wire tag.

Appendix 4. Black Creek, French Creek and Trent River coded-wire tag data for 1988.

Black Creek

Date caught	Date tagged	Large tag code	No. large tagged	Large cum. total	Small tag code	No. small tagged	Small cum. total	Tag Morts.	No. held	Hours held	% reten.	Tags lost
April 11	April 13	8/24/51	25	25	8/24/40	8	8	3	0			
April 12	April 13	8/24/51	30	55	8/24/40	34	42		0			
April 13	April 13	8/24/51	10	65	8/24/40	6	48		0			
April 14	April 15	8/24/51	9	74	8/24/40	7	55		0			
April 15	April 15	8/24/51	6	80	8/24/40	5	60		0			
April 16	April 16	8/24/51	22	102	8/24/40	2	62		0			
April 17	April 18	8/24/51	42	144	8/24/40	7	69		64	24	100	0
April 18	April 18	8/24/51	48	192	8/24/40	16	85		0			
April 19	April 19	8/24/51	31	223	8/24/40	4	89	1	0			
April 20	April 21	8/24/51	80	303	8/24/40	11	100		0			
April 21	April 22	8/24/51	33	336	8/24/40	6	106		0			
April 22	April 23	8/24/51	87	423	8/24/40	15	121		0			
April 23	April 23	8/24/51	72	495	8/24/40	19	140	2	0			
April 24	April 25	8/24/51	288	783	8/24/40	50	190		0			
April 25	April 25	8/24/51	83	866	8/24/40	3	193		0			
April 26	April 26	8/24/51	575	1,441	8/24/40	95	288		0			
April 26	April 27	8/24/51	0	1,441	8/24/40	34	322		0			
April 27	April 27	8/24/51	83	1,524	8/24/40	29	351	2	0			
April 28	April 30	8/24/51	250	1,774	8/24/40	33	384	1	0			
April 29	April 29	8/24/51	2,128	3,902	8/24/40	124	508	1	100	24	99	1
April 30	April 30	8/24/51	742	4,644	8/24/40	137	645	1	0			
May 1	May 2	8/24/50	397	5,041	8/24/41	73	718		0			
May 2	May 3	8/24/50	110	5,151	8/24/41	20	738		0			
May 3	May 3	8/24/50	1,449	6,600	8/24/41	117	855	1	0			
May 4	May 5	8/24/50	1,607	8,207	8/24/41	383	1,238	4	0			
May 5	May 5	8/24/50	740	8,947	8/24/41	229	1,467		100	48	100	0
May 6	May 7	8/24/50	816	9,763	8/24/41	368	1,835					
May 7	May 7	8/24/50	811	10,574	8/24/41	423	2,258	1	100	48	100	0
May 8	May 9	8/24/50	1,142	11,716	8/24/41	661	2,919	1	0			
May 9	May 9	8/24/50	2,355	13,071	8/24/41	804	3,723		0			
May 10	May 11	8/24/50	1,163	14,234	8/24/41	656	4,379		0			
May 10	May 11	8/24/49	409	14,643	8/24/41	0	4,379		0			
May 10	May 12	8/24/49	1,416	16,059	8/24/41	1,202	5,581		0			
May 11	May 11	8/24/49	1,501	17,560	8/24/42	705	6,286		171	24	99	2
May 12	May 12	8/24/49	1,975	19,535	8/24/42	2,871	9,157	4	0			
May 13	May 13	8/24/49	506	20,041	8/24/42	310	9,467		600	24	100	1
May 14	May 15	8/24/49	660	20,701	8/24/42	1,154	10,621		0			
May 15	May 16	8/24/49	178	20,879	8/24/42	1,620	12,241		0			
May 16	May 16	8/24/49	954	21,833	8/24/42	3,007	15,248		0			
May 16	May 16	8/24/49	0	21,833	8/24/43	1,485	16,733		0			
May 16	May 17	8/24/48	1,031	22,864	8/24/43	3,362	20,095		0			
May 17	May 17	8/24/48	377	23,241	8/24/43	1,763	21,858		100	24	100	0
May 18	May 18	8/24/48	200	23,441	8/24/43	2,337	24,195		0			
May 19	May 19	8/24/48	241	23,682	8/24/43	1,377	25,572		0			
May 19	May 19	-	0	23,682	8/24/46	1,346	26,918		100	24	99	1
May 20	May 20	8/24/47	113	23,795	8/24/46	1,610	28,528	4	100	24	99	1

Appendix 4. Black Creek, French Creek and Trent River coded-wire tag data for 1988.

Black Creek

Date caught	Date tagged	Large tag code	No. large tagged	Large cum. total	Small tag code	No. small tagged	Small cum. total	Tag Morts.	No. held	Hours held	% reten.	Tags lost
May 21	May 21	8/24/47	130	23,925	8/24/46	1,465	29,993	3	0			
May 22	May 22	8/24/47	48	23,973	8/24/46	789	30,782		0			
May 23	May 23	8/24/47	441	24,414	8/24/46	4,150	34,932		0			
May 24	May 24	8/24/47	21	24,435	8/24/46	510	35,442		100	24	100	0
May 25	May 25	8/24/47	100	24,535	8/24/46	256	35,698	3	100	24	100	0
May 25	May 25	-	0	24,535	8/24/59	1,262	36,960		0			
May 26	May 26	8/24/61	14	24,549	8/24/59	260	37,220		0			
May 27	May 27	8/24/61	6	24,555	8/24/59	206	37,426		100	24	100	0
May 28	May 28	8/24/61	78	24,633	8/24/59	1,195	38,621		100	24	100	0
May 29	May 29	8/24/61	688	25,321	8/24/59	3,536	42,157	9	100		100	0
May 30	May 30	8/24/61	141	25,462	8/24/59	887	43,044		100	24	100	0
May 31	June 1	8/24/61	30	25,492	8/24/59	522	43,566		0			
June 1	June 1	8/24/61	16	25,508	8/24/59	461	44,027		0			
June 2	June 3	8/24/61	433	25,941	8/24/59	1,960	45,987					
June 3	June 5	8/24/62	192	26,133	8/24/60	628	46,615					
June 4	June 5	8/24/62	68	26,201	8/24/60	543	47,158					
June 5	June 5	8/24/62	17	26,218	8/24/60	429	47,587		100	48	100	0
June 6	June 7	8/24/62	10	26,228	8/24/60	244	47,831	1				
June 7	June 7	8/24/62	3	26,231	8/24/60	213	48,044	2				
June 8	June 9	8/24/62	1	26,232	8/24/60	255	48,299		100	48	100	0
June 9	June 9	8/24/62	2	26,234	8/24/60	147	48,446					
June 10	June 11	8/24/62	0	26,234	8/24/60	74	48,520					
June 11	June 11	8/24/62	2	26,236	8/24/60	116	48,636					
June 12	June 12	8/24/62	3	26,239	8/24/60	201	48,837	1				
June 13	June 14	8/24/62	2	26,241	8/24/60	24	48,861					
June 14	June 14	8/24/62	0	26,241	8/24/60	38	48,899					
June 15	June 15	8/24/62	0	26,241	8/24/60	22	48,921					
June 16	June 16	8/24/62	2	26,243	8/24/60	15	48,936					
June 17	June 17	8/24/62	2	26,245	8/24/60	51	48,987					
June 18-20	June 20	8/24/62	0	26,245	8/24/60	14	49,001					

Appendix 4. Black Creek, French Creek and Trent River coded-wire tag data for 1988.

French Creek

Date caught	Date tagged	Tag code	No. tagged	Cum. total	Morts.	No. held	No. Hours	rejects
April 14-17	April 17	8/24/35	59	59	1			
April 18-19	April 20	8/24/35	70	129	0			
April 21	April 22	8/24/35	26	155	0			
April 22	April 22	8/24/35	50	205	0			
April 23	April 24	8/24/35	34	239	2			
April 24	April 24	8/24/35	13	252	0			
April 25-28	April 28	8/24/35	63	315	0			
April 29-30	April 30	8/24/35	103	418	0			
May 1-2	May 2	8/24/35	110	528	1			
May 3-4	May 4	8/24/35	75	603	1			
May 5-8	May 8	8/24/35	354	957	0			
May 9-10	May 10	8/24/35	377	1,334	3			
May 11-13	May 13	8/24/35	1,534	2,868	5			
May 14-16	May 16	8/24/35	1,112	3,980	2			
May 17-18	May 18	8/24/36	977	4,957	0			
May 19-20	May 20	8/24/36	1,729	6,686	2	100	48	0
May 21	May 21	8/24/36	597	7,283	1			
May 22-23	May 24	8/24/36	4,000	11,283	1			
May 24	May 25	8/24/36	858	12,141	7			
May 25	May 25	8/24/36	930	13,071	1			
May 26-27	May 27	8/24/37	2,275	15,346	1			
May 28-29	May 29	8/24/37	2,213	17,559	0			
May 30	May 31	8/24/37	1,429	18,988	0			
May 31	May 31	8/24/37	1,217	20,205	8	100	48	1
June 1-2	June 2	8/24/37	1,323	21,528	0	100	48	1
June 3	June 4	8/24/37	725	22,253	0			
June 3	June 4	8/24/37	632	22,885	0			
June 4	June 4	8/24/37	1,507	24,392	0			
June 5	June 6	8/24/37	354	24,746	0			
June 6	June 6	8/24/37	184	24,930	0			
June 7	June 8	8/25/3	302	25,232	4			
June 8	June 8	8/25/3	505	25,737	2	164	48	2
June 9-10	June 10	8/25/3	363	26,100	0			
June 11-13	June 13	8/25/3	518	26,618	0			

Appendix 4. Black Creek, French Creek and Trent River coded-wire tag data for 1988.

Trent River

Date caught	Date tagged	Tag code	No. tagged	Cum. total	Tagging morts.	No. retained	Hours held	Rejects
April 16-18	April 18	8/24/38	23	23				
April 21	April 22	8/24/38	8	31				
April 22	April 22	8/24/38	61	92				
April 23	April 25	8/24/38	26	118				
April 24-25	April 25	8/24/38	66	184				
May 2-4	May 4	8/24/38	123	307				
May 5	May 8	8/24/38	197	504				
May 6	May 8	8/24/38	570	1,074				
May 7-8	May 8	8/24/38	425	1,499				
May 9	May 10	8/24/38	690	2,189	1			
May 10	May 10	8/24/38	143	2,332				
May 11	May 14	8/24/38	105	2,437				
May 12	May 14	8/24/38	754	3,191				
May 13	May 14	8/24/38	1,281	4,472				
May 14	May 14	8/24/38	560	5,032				
May 15	May 17	8/24/38	764	5,796	1			
May 16	May 17	8/24/38	401	6,197				
May 17	May 17	8/24/38	145	6,342	1			
May 18	May 19	8/24/38	384	6,726				
May 19	May 19	8/24/38	1,370	8,096		100	24	1
May 20	May 21	8/24/38	1,056	9,152				
May 21	May 21	8/24/38	868	10,020				
May 22	May 22	8/24/38	424	10,444				
May 22	May 24	8/24/39	710	11,154	1			
May 23	May 24	8/24/39	1,269	12,423	1			
May 24	May 26	8/24/39	375	12,798				
May 25	May 26	8/24/39	823	13,621				
May 26	May 26	8/24/39	876	14,497				
May 27	May 28	8/24/39	503	15,000				
May 28	May 28	8/24/39	1,673	16,673				
May 29	May 30	8/24/39	1,141	17,814	3			
May 30	May 30	8/24/39	148	17,962				
May 31-	June 3	8/24/39	522	18,484		100	24	1

Appendix 5. Number of ventral clipped coho smolts recovered at the French Creek trap during 1988.

Date caught or tagged	Marked coho: Left ventral	Right ventral	total	Tag code	No. tagged	Cum. total
April 17	9	3	12	8/24/35	59	59
April 20	0	0	0	8/24/35	70	129
April 21	9	0	9	8/24/35	26	155
April 22	5	0	5	8/24/35	50	205
April 23	5	2	7	8/24/35	34	239
April 24	2	0	2	8/24/35	13	252
April 28	14	4	18	8/24/35	63	315
April 30	11	1	12	8/24/35	103	418
May 2	2	0	2	8/24/35	110	528
May 4	12	0	12	8/24/35	75	603
May 8	48	0	48	8/24/35	354	957
May 10	53	2	55	8/24/35	377	1,334
May 13	162	0	162	8/24/35	1,534	2,868
May 16	47	0	47	8/24/35	1,112	3,980
May 18	49	0	49	8/24/36	977	4,957
May 20	0	0	0	8/24/36	1,729	6,686
May 21	0	0	0	8/24/36	597	7,283
May 23	115	0	115	8/24/36	4,000	11,283
May 24	12	0	12	8/24/36	858	12,141
May 25	10	0	10	8/24/36	930	13,071
May 27	33	0	33	8/24/37	2,275	15,346
May 29	25	0	25	8/24/37	2,213	17,559
May 30	10	0	10	8/24/37	1,429	18,988
May 31	0	0	0	8/24/37	1,217	20,205
June 2	3	0	3	8/24/37	1,323	21,528
June 3	0	0	0	8/24/37	1,357	22,885
June 4	2	0	2	8/24/37	1,507	24,392
June 5	2	0	2	8/24/37	354	24,746
June 6	0	0	0	8/24/37	184	24,930
June 7	5	0	5	8/25/3	302	25,232
June 8	2	0	2	8/25/3	505	25,737
June 10	7	1	8	8/25/3	363	26,100
June 13	1	1	2	8/25/3	518	26,618
Sum	655	14	669			